Devoted to Civil Engineering and Contracting. McGraw-Hill Publishing Company, Inc.

JUN 6 1927

June 2, 1927

Engineering News-Record

Double-Decking Highway Bridge Over the Susquehanna in Maryland

Developing Traffic-Bound Roads at Low Cost, by Harry J. Kirk

Double-Decking the Havre-de-Grace Highway Bridge, by John N. Mackall

Building a 200-Mile Oil Pipe Line

Depreciation Becomes of Greater Importance to Railroads, by Henry J. Saunders

KREOLITE

Outlast the Factory

Save Overhead, Under Foot

THE floor is the *base of operations* for men, machines and material. It either facilitates production or retards it. Uneven, cold, clammy floors, dust, dampness, rust and disease pull down workmen and slow up work.

One man can handle a truck on the smooth surface of these impregnated blocks that requires the strength of *two* men on other floorings. Best of all, once laid Kreolite Blocks *permanently* end your floor problems. Their grooved construction makes provision for expansion and allowance for shrinkage. Kreolite Filler penetrates through the grooves to the very base, binding the blocks into a compact, sanitary unit.

Hundreds of manufacturers in all lines of business machine shops—foundries warehouses—paper mills, etc., bear testimony to the wonderful results accomplished with Kreolite Floors.

Prices now as low as 24c. per sq. ft., installed complete.

Kreolite floors can be laid without interfering with production.

The Jennison-Wright Company
Toledo, Ohio

WOOD BLOCK FLOORS

A Consolidation of Engineering News, Engineering Record and The Contractor

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

McGraw-Hill Publishing Co., Inc.
JAMES H. McGRAW, *President*
E. J. MEHREN, *Vice-President*

FRANK C. WIGHT
Editor

Volume 98 · NEW YORK, JUNE 2, 1927 · Number 22

Cold Facts, Not Theory

BECAUSE *Engineering News-Record* is not publishing articles telling how to solve the Mississippi River flood problem does not mean that such articles have not been submitted for publication. They are coming in fast and numerous. But they offer little that is new and nothing that is helpful. The Mississippi problem is an old one. Its literature is extensive, and it covers about everything that is now being said. A similar reticence, however, does not pervade the editorial offices of our newspapers and magazines, so the country may expect a steady flow of paper and ink for the next few months all devoted to expert plans to stop the river from flooding. Reservoirs and parallel rivers will get most of the free advertising. Already Chairman Dempsey, of the House Rivers and Harbors Committee, has rushed into print with a prospective bill for the creation of basins throughout the great valley. So far he has not presented figures, either of what prevention of this sort would cost or balanced against it what is the value of the land and industry to be saved by protection. Some of the parallel channel enthusiasts, however, may like to know that a sordid minded engineer out in Arkansas has sent in to us an estimate of the cost of two new channels to carry the flooded river's surplus. With very fair unit prices and a reasonable quantity survey he finds the cost to be $189,838,537,776! Reservoir advocates might indulge in similar arithmetical exercise.

Query Wanaque Aqueduct Changes

CONTINUED refusal of the North Jersey District Water Supply Commission to furnish this journal with copies of the engineering reports for and against its change from a concrete conduit to steel pipe for the Wanaque aqueduct has its own obvious connotation. But denial of the reports to an engineering journal is a small matter compared to withholding them from the governing bodies and taxpayers of the contracting municipalities who foot the bills. The attitude of the commission in this matter has not only strengthened the fear of some of the contracting cities that the change will materially increase the cost of the aqueduct, as the commission's original engineers contend, but it has brought to a head a long-standing dissatisfaction of the contracting cities with the methods of both the water commission and the Passaic Valley Sewerage Commission, which together serve as agents for some 20 cities and towns. A movement to have all proposed action of both these commissions which would result in additional financial obligations on the part of the communities submitted to their governing bodies ten days before final action is reported elsewhere in this issue. These happenings are of general interest because of the rapidly growing number of district water and sewerage commissions. Those who foot the bills incurred by such commissions would do well to find out how near they are to compliance with the principles of representative government and accountability to taxpayers.

Dirt Road Praise

IT is rare for a state highway department to point with pride to its record of earth road building. This is one distinction of the Ohio road article in this issue in the series on outstanding examples of state highway work. There are, however, broader claims for consideration by engineers of the road work being done in Ohio in developing its more remote rural roads. The dirt road has been called the three-million-mile road system and surfaced roads the three-hundred-thousand-mile road system of America. All efforts, and they can hardly become too great, to provide surfaced roads cannot hope to redeem half the miles of the dirt road system from their homely position. And it is not desirable even that redemption should be comprehensive. This does not, however, eliminate the obligation to provide better dirt roads. Ohio is not alone among states in sensing this obligation and in taking practical steps to satisfy it. Recent writings and investigations indicate that everywhere in the road-building industry active minds are setting themselves to the task. But Ohio's announced policy of making a feature of traffic-bound roads in its regular program and the work it has actually done are deserving of special mention. That its policy and construction have commanded popular approval was to be expected, but it is, nevertheless, satisfying to have expectation so fully realized. The favorable reaction will be influential in a larger way in the encouragement it gives to those who have set out to study the dirt road problem to fetch back the best solution.

A Municipal Departure

RADICALLY new municipal policy is represented in the proposal of the governing authorities of New York City to build a large new bridge on the toll-refunding principle. They make this proposal as to the Triborough Bridge project, which contemplates a structure connecting the borough of Queens with Manhattan and the Bronx at a cost likely to reach twenty-five or thirty million dollars. This is the first modern occasion, we believe, where the proposal for refunding by tolls has been proposed for a municipal bridge serving interior communication only. The nearby bridges now being built by the Port Authority to connect New York and New Jersey are interstate, and lie on the boundaries of the city, so that they are more analogous to the Poughkeepsie and Bear Mountain bridges, or for that matter the newly opened Carquinez Strait bridge, than to city traffic bridges. Offhand, it seems like turning the clock back a century or two to depart from the policy of keeping all municipal highways free and open.

But it is more to the point to consider the Triborough proposal as a new bit of evidence of the rapidly growing money demands of modern city life. The tolerable limits of taxation have already been exceeded in many places, and yet ever more and better facilities are demanded and new works of ever greater cost are called for. Under these circumstances it does not appear wholly unreasonable that a municipality should resort to a pay-as-you-go plan and endeavor to place the burden for a special service upon its users, who (in this particular case, at least) are certain to derive a definite money advantage from the new facility.

A Field for Study

IT IS a favorite device of highway economics to determine the warranted cost of road improvement by capitalizing the savings to the road users. Of undoubted validity from a theoretical standpoint it suffers somewhat practically because by it it is so easy to prove that expenditures far beyond any ever made are worth while to the community if all of the savings from easier traction, less gasoline and oil, less wear and tear, etc. are balanced against the cost of a better road. It is therefore only in an academic fashion that the thought is advanced that the physical labor, mental anguish, and depreciated automobile value that follow a five-mile tour over a newly oiled road would readily capitalize into two or three times the cost of a hard, smooth, dry, clean highway. If the oil experts want to advance highway practice they should put their minds to devising a road oil that will stick to the road but not to the automobile.

Murder Will Out

THAT murder will out is illustrated with fresh horror by the futile attempts of the Montreal city authorities to suppress information when the already unprecedented epidemic of typhoid fever broke out anew in its tenth week and soon mounted higher than in the fourth week, which was supposed to be the crest. The attitude of the city council both in suppressing reports of the number of cases and in failing to act on the order of the Provincial Board of Health to close the dairies held by the bureau to be responsible for the epidemic is criminal, ignorant and ridiculous.

Irrigation and the Future

DIRECTLY or indirectly, nearly half of the United States is intimately dependent on irrigation. Both the general development and the engineering activity of these regions are involved in the stability of irrigated agriculture, and doubtless will remain so not only now but in the long future. It is therefore a matter of critical importance if conditions are developing that imply any threat to the continued soundness of irrigation.

Most American irrigation is of recent development. With few exceptions, it is less than three decades old. As a business enterprise it rests on the tacit assumption that irrigation will continue to be effective and will produce undiminished crops for generations to come. Unless that assumption is valid, the whole of the vast financial and social structure of irrigated agriculture must soon begin to crumble. But it has appeared recently, as more has been learned of the art, that in some districts the crop yields are decreasing—and this not because of less careful or expert farming, but because of some obscure factors that lie behind the farmer's work. Weather, plant pests and similar crop hazards are not to blame, but on the contrary the irrigation system itself seems to be at fault. This sensational discovery raises profound question as to the permanence of irrigated agriculture.

Investigations made during recent years indicate that certain physical (or perhaps physical and chemical) actions are at work in irrigated soil which foreshadow a troubled future for some if not all of the projects that now seem to have the fairest outlook. Chief of these actions is the progressive accumulation in the soil of mineral salts brought in by the water and not removed but left in the root zone.

These salts are not assimilable by crop plants, and make it steadily harder for the plants to survive and flourish. Ultimately, if cropping should continue so long, the salt burden in the soil would reach a limit at which the plants could no longer exist, and the land then would be wholly unproductive. But probably long before this the land would have been abandoned, as being too poor to repay the cost of cultivation. The land goes out of cultivation and productive irrigation is at an end.

In one highly fruitful tract of land it has been found that the soil is receiving an annual increase of alkali salts in the amount of nearly 2 tons per acre. Not many decades of accumulation at this rate will have to go on before there will be a fatal decrease in productiveness of the land. The tract has been farmed for 20 years or more, and as a whole it is still producing excellent yields. In its earlier years the water was applied in sufficient abundance to permit of an amount of downward percolation which carried away the salt; as fuller development came about, however, the water had to be used more sparingly, and under this condition large quantities of the salt content of the original water remain in the soil. The effects are already discernible, on careful analysis of crop records, in lowered yield per acre.

Limitation of water supply is not the only factor in this evolution. On the project in question there is, as in all irrigation regions, difficulty in draining away the water that enters the soil from irrigation flooding and from canal leakage, and it is questionable whether heavier applications of water are feasible without a very great increase in sub-drainage facilities. Already parts of the project are waterlogged or "seeped," and therefore have been rendered sterile. But in addition many parts of the area which have no trace of waterlogging are showing reduced yields, so far as the rather variable results of agriculture permit of reliable numerical comparison.

The case cited is one whose water supply comes from a stream unusually high in salinity. This, however, is only a relative matter. Every Western stream in its lower course contains higher percentages of dissolved salts than are found in regions where rainfall is ample, and, while there is reason to think that not all the mineral salts are objectionable, it is certain that all irrigation waters contain a significant proportion of substances that become harmful when in sufficient concentration. For this reason it is hardly open to doubt that the same effects as noted for the one project are going on in other irrigation regions also, though per-

haps in lesser degree, requiring a longer time to develop the same salt "poisoning" of the soil. There are, in fact, actual observations upon several important projects other than the one cited, to confirm this conclusion. In short, there is the best of reason for believing that basically the condition is general. Thus, it constitutes a cloud overhanging the whole horizon of irrigation practice.

The trouble is not without remedy, fortunately. But the remedy requires a change of method which in at least some cases would be profound. Heavy curtailment of the area irrigated would be involved. The remedy is a sufficiently large supply (and use) of water to result in some downward percolation past the root zone into the subjacent region of underdrainage whereby the superconcentrated soil solution would be continuously removed.

It is plain that this calls for what now would be regarded as an excess of water. In districts whose development has been carried to a high point by economy in water use, the required supply is not to be had unless the farmed areas are reduced in size. The difficulties in the way of such reduction are apparent; the farmer whom it is proposed to cut off from the supply and relegate to the desert is not apt to submit gracefully. Further, drainage facilities much more ample than under present practice must be provided, in order to carry off the greater flow of irrigation water. In many projects as now constructed and operated, the application of heavier irrigation would involve the danger of increasing the area of waterlogged lands. But quite as important as providing additional drainage facilities is it to prevent inflow of water from canal-bottom leakage, at present a very important cause of overburdening of the subdrainage system, and a source of waterlogging. Unless this canal water is confined to its proper place, the drainage system must do double service, and is likely to fail in its vital function of carrying off the percolation from the irrigating water.

Many irrigation projects have already progressed beyond the point where these various requirements can easily be met. They would call for rigid regulatory control, and drastic modification of construction and operating systems. These projects therefore face a problem of great magnitude. It may have to be solved by future engineering and agricultural changes, and doubtless much costly construction. But above all it calls for early and incisive study, and prompt preparation for the difficult administrative tasks without which the remedial measures cannot be applied successfully.

Necessary preliminary steps are determination of water duty in terms of plant consumption and evaporation, regular measurement of salt balance, determination of the required volume and frequency of leaching, and no doubt in many instances either increase of water supply or such restriction of area as will give a surplus available for percolation. Following these measures, it will be proper to consider what extension of drainage facilities will provide for carrying away the water.

More difficult than these steps, however, is it to obtain the support without which studies and improvements of the kind cannot be undertaken on a particular project. The agricultural community is not apt to approve of costly and irksome changes in system until convinced by its own personal observation of reduced crops and land values that the evil to be guarded against is real and is already present. But to let the evil sequence of soil actions proceed unchecked to this extent would endanger the prosperity of large regions and thriving populations, and would unquestionably involve large losses, both temporary and permanent. To forestall such losses it would be well if irrigation engineers and their societies were to exert themselves in spreading among the irrigators proper knowledge of the facts and advocating timely consideration of remedial measures. The circles of irrigation finance also have opportunity to work to good effect in this direction; the great bulk of irrigation securities and farm mortgages is the most vulnerable part of the values at risk.

Juggling Railroad Accounts

IDEAS as to the correct method of setting up depreciation accounts for public utility properties are about as diverse as are opinions as to how such properties should be valued. Consequently, the recent order of the Interstate Commerce Commission directing the railroads of this country to set up depreciation reserves, outlined elsewhere in this issue, is of considerable interest outside of the railroad field. The method proposed for computing depreciation is not unusual but the procedure by which the results are to be worked into the railroad companies' accounts is very much so and is open to severe criticism.

The railroads carry depreciation accounts for equipment such as cars and locomotives, but few have set up reserves for such fixed property as roadway and structures except in the case of some large bridges; the renewal of rails, cars and small structures being charged to operating expenses as they occur, a procedure which, in effect, has made a depreciation reserve for such property unnecessary. Now, the commission has ordered the railroads to redistribute their investment accounts in order to assign certain amounts to depreciation reserves for these, by far the larger items on their property account. There is only one place from which the money for such reserves can come, from surplus. But if this is done, the surplus of many roads would be wiped out and their credit impaired. Recognizing this, the commission has included in its order a method of procedure which authorizes the railroads to set up on the asset side of their balance sheet a "suspense account to offset the depreciation reserve which is to be figured for their entire fixed property, the suspense account to be gradually extinguished by charges to profit and loss in future use." Obviously, this account will not be an actual asset but merely a fictitious one too much like the "watered stock" of past railroad history to be stamped with the seal of approval of the Interstate Commerce Commission.

Just why the commission has taken such a radical step is not apparent, but on the surface it looks as if it had given official sanction to what amounts to irregular methods of accounting merely to give immediate effect to a system of keeping depreciation records which would otherwise require to be inaugurated over a long period of years. If such is the case the action of the commission is reprehensible. Railroad accounts have been juggled by the owners in the past on the grounds of expediency. The commission should not authorize similar juggling on the same ground just to simplify its records.

One of a Series of Articles on
OIL FIELD ENGINEERING

Building a 200-Mile Oil Pipe Line

Unusual Problems Presented by a Shifting Topography, a 4,800-Ft. River Crossing and the Viscous Nature of the Oil to Be Transported

THE CONSTRUCTION and engineering problems usually encountered in building an oil pipe line have been considerably augmented on a welded line now being constructed by the Prairie Pipe Line Co. out of the oil field in the Texas Panhandle. One of the principal factors that has given this line its unusual character is the nature of the crude oil that must be transported. The oil has a high content of paraffin which causes it to congeal at ordinary temperatures, at or near 55 deg. F. As a direct result, the pipe must be buried whenever possible to a depth about 14 in. greater than any maximum depth heretofore used, special insulation must be provided where pipe is exposed to the atmosphere, and the oil must be heated during the winter months. Design and construction centering around these factors have been unusual in oil pipe line work. The topographical character of the territory through which the line passes has also added to the difficulty of location and construction. As shown in Fig. 1, the line starts at Kings Mill, Tex., and follows a southeasterly route to Ringling, Okla., where it connects with the main trunk lines north and south. The topography varies from flat plains country, excellent for pipe line construction, to a so-called "break" country cut by shifting ravines and canyons. The latter is some of the most treacherous country which any pipe line has had to traverse. A major construction problem also developed where the line crossed the north fork of the Red River, east of Blair, Okla. A shifting stream bed, quicksand and danger from floods were some of the difficulties to be met.

In design, in location, in construction and in operation, this 200-mile pipe line has not only presented unusual problems, but is an excellent example of the present-day engineering methods used in oil pipe line construction. This article will consider both the extraordinary difficulties and the more or less conventional procedure being used.

Background and General Characteristics—Phenomenal oil development of the Texas Panhandle north and east of Amarillo began in the spring of 1926. The territory was typical plains cattle country, no pipe line ran within hundreds of miles of the field, and the nearest railroad was 25 miles away. The production, now around 125,000 bbl. a day, at one time reached a peak of 150,000 bbl., all of which has had to be stored or shipped out in tank cars mostly on railroads recently built into the field. The producing companies in most cases built gathering pipe lines of their own which brought the oil

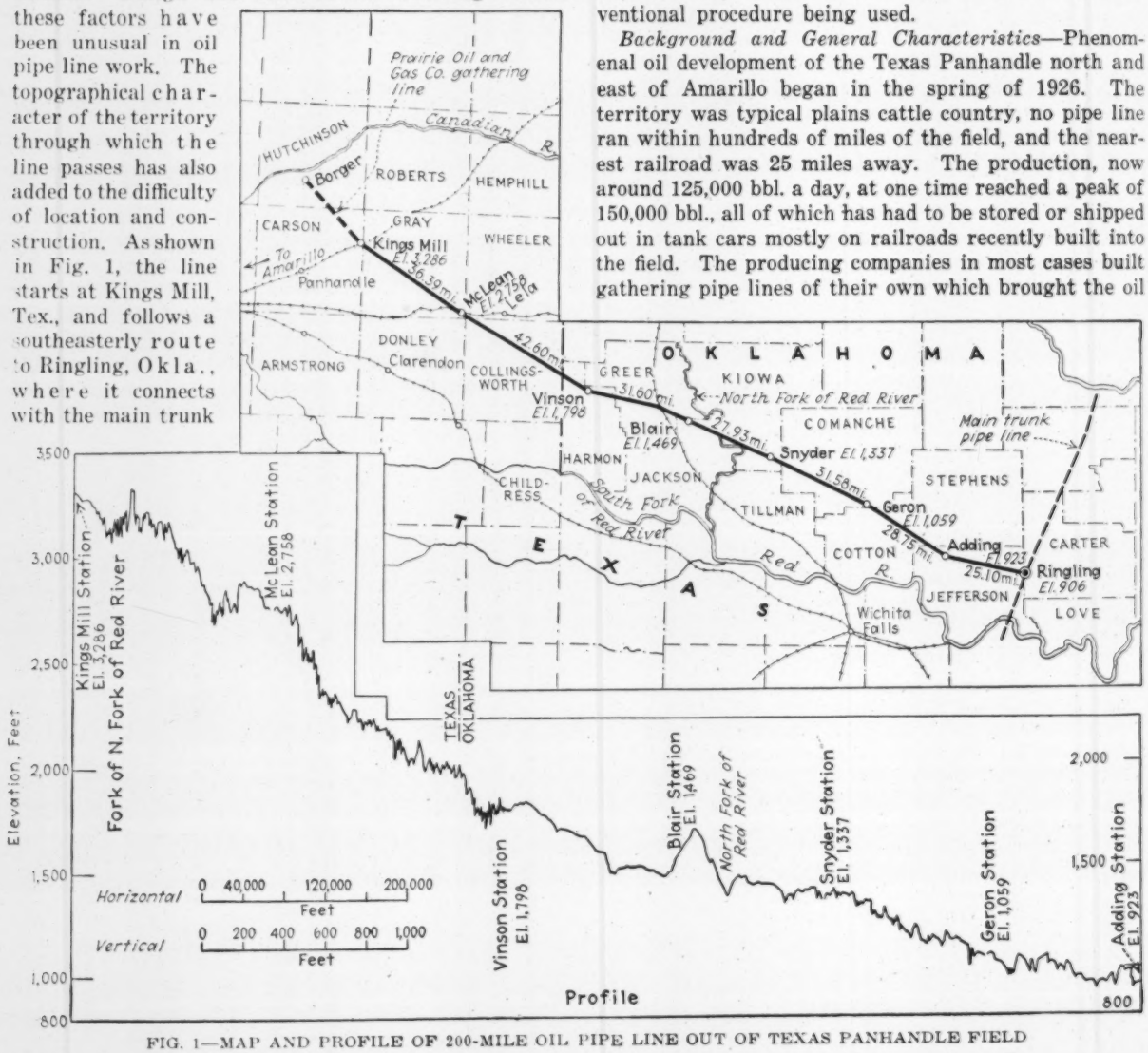


FIG. 1—MAP AND PROFILE OF 200-MILE OIL PIPE LINE OUT OF TEXAS PANHANDLE FIELD

to the car loading racks on the railroad sidings. Such a line is illustrated in Fig. 1 by the line of the Prairie Oil & Gas Co. from Borger to Kings Mill. Other companies deliver to a new branch of the railroad which has been built from Panhandle to Borger. No pipe lines have as yet been completed giving an outlet to the field,

FIG. 2—HAULING A 35-TON PUMP FROM RAILROAD TO PUMPING STATION
Nine 3½-ton trucks hooked tandem were necessary.

though it is expected that the one here described will be finished and ready for operation early in June. Two other lines are being built, one of which will be completed at about the same time. There is much conjecture as to how efficiently the lines will operate, not only on account of the high congealing temperature but also because of the sulphur content of the oil which is proving to be an especially destructive corrosive agent.

As stated, the line is 200 miles long. It uses seven pumping stations, varying from 28 to 42 miles apart depending upon the topography of the country. In other words, the line is designed for a maximum pumpage over its entire length of 24,500 bbl. per 24 hr., this calculated on the basis of 700-lb. pressure. The oil is received at each station in a 30,000-bbl. steel working tank from which it flows by gravity to the pumps which force it through the line to the next station below. The discharge or main line is 8-in. steel pipe while the suction line from the working tanks to the pumps is 12 in. All joints are welded.

The sequence of operations in building this oil pipe line may be grouped somewhat as follows: (1) Location and design, (2) preliminary work, (3) welding procedure, (4) cleaning and covering, (5) ditching and backfilling, (6) station construction, (7) placing a river crossing.

To carry out these operations required a total of some 400 or 500 men. These forces were divided among three contractors and the Prairie Pipe Line Co. in a ratio of about 1 to 4. The pipe stringing, the ditching and the protective coating were contract work. About 40 men were used in pipe stringing, about 25 for ditching, and the force of the protective coating contractor averaged about 20 men. The remainder of the work was done by company forces, varying from 350 to 400 men.

Location and Design—The first requirement to be satisfied by this line was that it connect with a main pipe line at a point where the oil could reach as many buyers as possible, since the oil is as stated of special composition and probably at times will not be wanted by some refineries. Ringling, Okla., was chosen as the terminus since it is on the company's main line and oil can be transported from there east, north or south. Transfers to another pipe line system will take it to the refineries in Louisiana. Thus, the starting point, Kings Mill, Tex., and the terminus, Ringling, Okla., were fixed.

It is universally true of pipe line location that a number of general requirements must be met by any route selected for a survey. The stations should be located as near a railroad as possible and on level, not too expensive, land. The line should run through enough railroad points to eliminate long hauls of materials, and at the same time should avoid towns. Ravines and bad river crossing should also be avoided. This line in its finished location satisfies the requirements in as large a measure as possible. All stations are reached by railroad spurs except one. This station, Vinson, on Fig. 1,

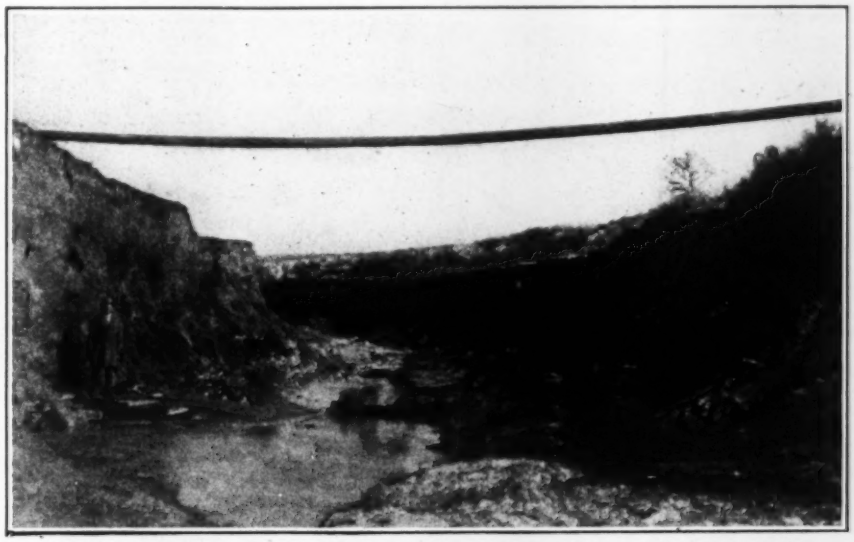


FIG. 3—PIPE LINE SPANNING ONE OF THE NUMEROUS SHIFTING RAVINES
This span of 200 ft. will later be held up by suspension cables.

required a 25-mile haul of materials. Fortunately, good roads were available and all but the heaviest equipment was transported without any difficulty. However, the heavy engines and pumps presented a problem which was solved as shown in Fig. 2, where nine 3½-ton trucks hooked tandem are transporting a 35-ton pump.

All but one bad river crossing and many ravine crossings were eliminated, although avoiding the latter caused much trouble. About one-quarter of the length of the line, 50 miles, approximately from McLean to Vinson, was in country filled with gullies and ravines. The

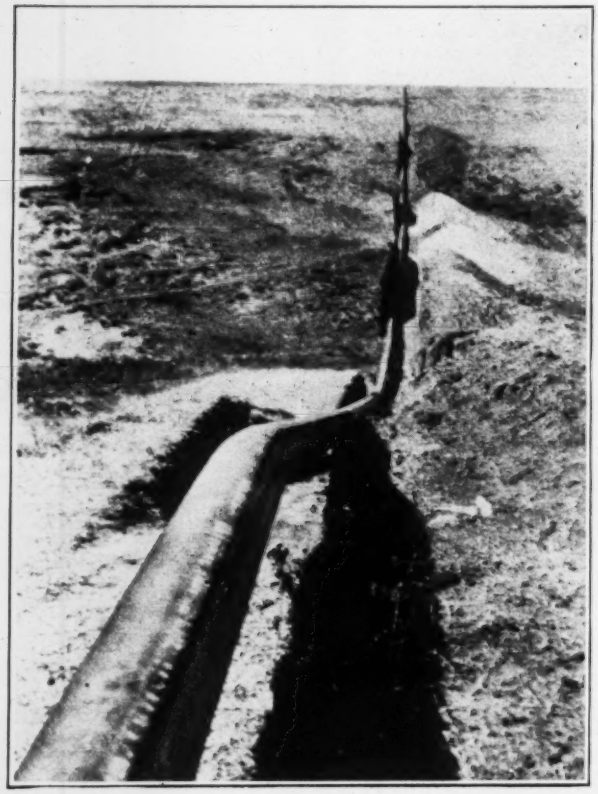


FIG. 4—PIPE LINE READY FOR FINAL DITCHING
The topography shown is that of some of the better country.

material is sandy red clay, dotted with outcroppings of gypsum rock. The clay is very erosive and the rock is soluble in water so that the ravines are widened and deepened by every rain. Their position is never fixed. Some are 300 to 400 ft. wide and 50 ft. deep, dry most of the time, but full from bank to bank several times a year.

No special difficulties were encountered on the survey in the ordinary plains country, the two parties averaging about 1 mile per day each. Stakes were set at 200-ft. stations for alignment; on former lines 100-ft. stations have been used. Special care was taken in setting turning points since no curves are laid out on an oil pipe line survey. The intermediate stakes did not need to be located so accurately since the alignment is not followed as closely as is a railroad center line. In fact, it may vary as much as 50 ft. either way from the stake line at a given point on account of the slack that is thrown into the pipe line to guard against expansion and contraction troubles. Elevations were taken at each stake by vertical angles, this being accurate enough on a pressure line. Although cut and fill are not given much consideration in laying out pressure lines, a profile was quite necessary for calculating the capacity of the line and in locating the stations. A profile is also used by the operating forces after the line is completed to determine toward which station a line should be drained in case of a break. Profiles are also useful when designing for an increase in capacity by "looping" which consists in adding parallel lines for a part of the distance between stations.

In the rough or "break" country three locations were surveyed before one was finally chosen. The latter followed very closely a ridge or divide between the drainage slope of the Elm Fork and the Salt Fork of the Red River. A fairly regular route was possible at this location while one-fourth mile on either side the country was practically impassable. At one point in a distance of one mile the final survey crossed only twenty ravines while the second survey had included about a hundred.

Pipe lines usually are buried 18 in. in cultivated land and somewhat less across timber and pasture. Because the Panhandle crude oil congeals at such high temperatures it was felt that this line should be buried 42 in. to protect it from the air temperatures in cold weather and to hold the heat given to it at each station. Most pipe lines follow the contour of the land across streams and ravines although many of them have been suspended. The latter seemed to be an impossible arrangement with this line and much time was spent trying to find a route where the ravine locations were not subject to such severe erosion that the pipe line could not be passed under the stream bed. This proved impossible and suspension across the worst ravines, Fig. 3, is being used with a special insulation covering the pipe. On smaller and fairly permanent stream beds the line follows the contour of the ground.

Preliminary Work—The purchasing of the right-of-way for this line was characterized by an absence of friction with the land owners who regarded the pipe line much as the settlers in an undeveloped country view a new railroad.

FIG. 5—PIPE CLAMP
Type of clamp used to line pipe preliminary to welding.

The pipe, in 40-ft. nominal lengths, was received at the various railroad sidings along the line and distributed by trucks. Eighteen 1½-ton trucks were used, each hauling three to six lengths of pipe according to road conditions. The light trucks proved a big advantage in eliminating much team stringing. On an average, about five teams were required to supplement the trucks along the worst parts of the right-of-way.

Preliminary ditching work by hand which shapes the contour of the land surface to the shape in which the

line will finally lie is an operation requiring considerable skill and judgment, for after the pipe is once bent it is extremely hard to change its shape. Because of the many ravines on this line, this preliminary hand ditching was a difficult and costly operation. In Fig. 4

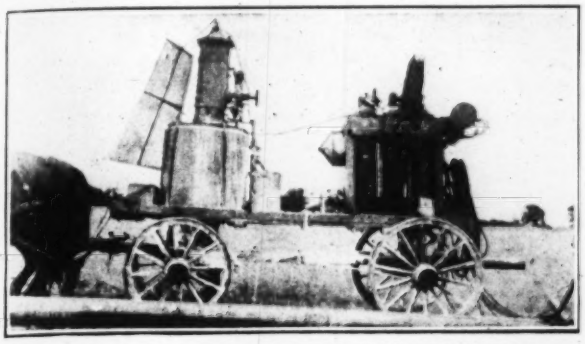


FIG. 6—OXY-ACETYLENE WELDING EQUIPMENT USED ON THE LINE

FIG. 7—BENDING THE PIPE TO CONTOUR
A crawler tractor (not shown) is placed on the pipe at the bend point.

is shown an example of the preliminary ditching, with the pipe laid. Final ditching mostly by machine will place the entire line 42 in. below the surface at all points.

Welding—Closely following the stringing and preliminary ditching work, a gang of men lined the pipe into five-length runs by means of clamps such as shown in Fig. 5. Oxygen-acetylene welding outfits, such as illustrated in Fig. 6, were used on this line. An acetylene generator with a capacity of 100 lb. and four oxygen cylinders supplied a gang of four men for 8 hr. Four of these outfits were used, each pulled along the line by a team of horses. Welders experienced in the pipe line work of the company were used exclusively. The five-length sections held in line with the clamps were first tacked, the clamps removed and a heavy ripple bead run around the joint. Four welders worked on each run of pipe.

The pipe in the runs of 200 ft. was bent to contour immediately after the welding. By placing a crawler tractor on the pipe at the point where the bend was to be made and having a gang of men walk onto the protruding pipe, over-bends were easily made. The pipe in Fig. 7 is just beginning to go down; the tractor is behind the pile of earth in the foreground. The tie-in welds completing the line were made by a gang of men and an outfit such as shown in Fig. 8. The 200-ft. lengths of pipe are turned with pipe tongs as the welding is done, while some overhead welding is necessary for the tie-in gang.

Cleaning and Covering—Corrosion is one of the major difficulties of pipe line companies. It is the subject of much research, and methods of prevention now in use are the stepchildren of countless theories. On this line the pipe has to be treated not only against corrosion but insulated against heat loss where exposed to the

FIG. 8—THE TIE-IN WELDING GANG
This gang welds the 200-ft. sections, thus completing the line.

atmosphere. The covering is therefore an important part of the work and one requiring considerable skill and knowledge.

In order to assure a good bond between the pipe and

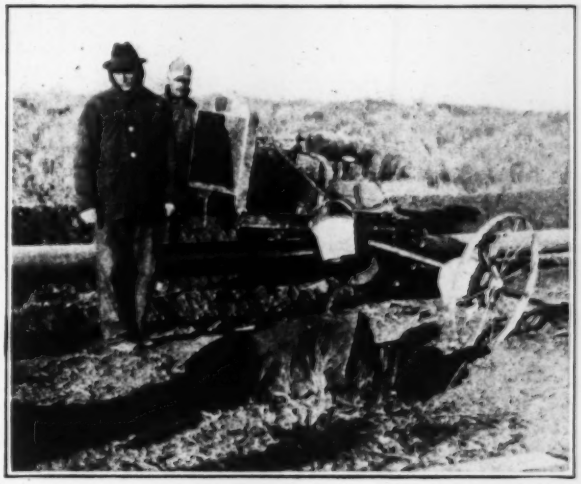


FIG. 9—SELF-PROPELLED PIPE-CLEANING MACHINE
This machine scrapes and brushes the pipe preliminary to the application of the protective coating.

the priming coat, the pipe was thoroughly cleaned. For this work the company has used the machine shown in Fig. 9. It consists of an automobile engine connected through a counter shaft and gears to a roller of small knife-edges which revolves about the pipe. Directly behind the cutters a wire brush revolves, removing the scale that has thus been loosened. The machine is self-propelled, moving along the pipe on the rollers

which may be seen beneath the front of the engine frame.

The complete covering consists of a priming coat of enamel, three coats of coal tar pitch and two coats of tarred felt, weighing 25 lb. per 100 sq.ft. On each 1,000 ft. of pipe line there were used 71 lb. of enamel, 1,422 lb. of double thickness tarred felt, and 3,000 lb. of waterproofing pitch. The cost of the covering was 16½c. per lineal foot. Each course of pitch and felt was de-

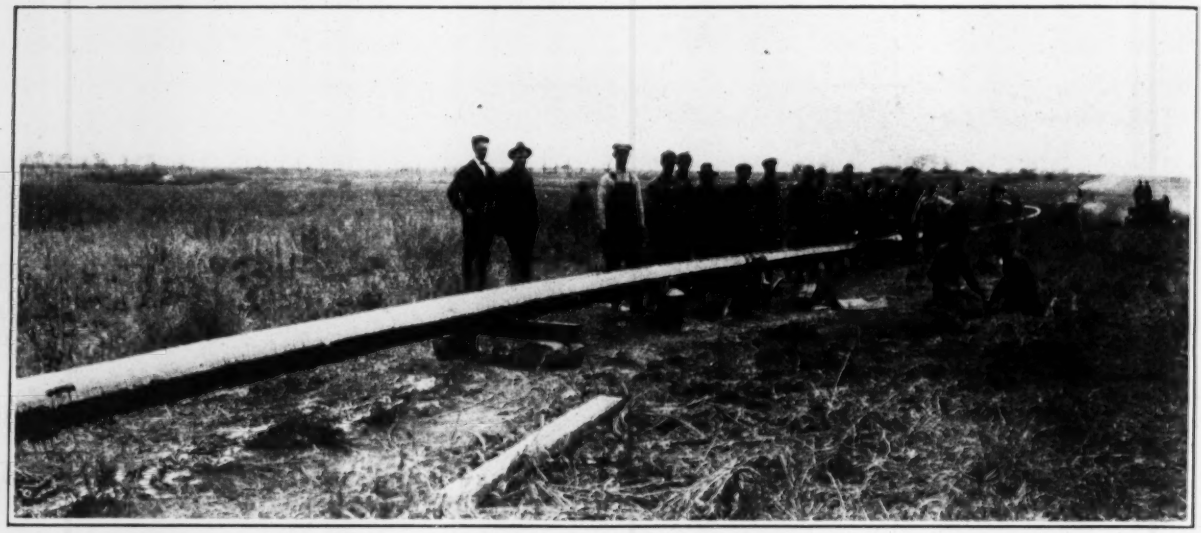


FIG. 10—SECTION OF PIPE ON WHICH THE PROTECTIVE COATING HAS BEEN COMPLETED
Note the wire wrapping, and at the left the reinforcing strip used on the welded joints in the river crossing.

signed to form a separate waterproof unit. Approximately 2 miles of pipe were covered per day.

The enamel or prime coat was applied from cans by hand brushing and was allowed a minimum set of 24 hr. before any wrapping was begun. Next a coating of pitch was applied by mopping and while hot a layer of double-tarred felt was embedded in it. The felt was applied in strips 36 in. long and wide enough to insure a 4-in. overlap. The second coating of pitch and felt was applied in the same manner, liberal coatings of hot pitch being used over and between each felt wrapper and a finish coating of hot pitch applied to the line. As an added precaution at the river crossing the same protective coating was used held in place by wires spaced at 6-in. intervals. Fig. 10 shows a completed wrapping and the insulating gang near the river crossing. Much care had to be used in lowering the pipe into the ditch to keep from disturbing the coating. A belt sling, illustrated in Fig. 11, was used for this purpose.

Ditching and Backfilling—The ditch for the line was dug by a wheel type machine. The trench was cut 42 in. and very little rock was encountered although on about 10 miles of the line small outcroppings were found, all of which could be easily blasted. In the "break" country the ditching contractor had a great deal of hand ditching to do. Backfilling was done by a Fordson tractor operating the backfilling board from a winch mounted in front of the radiator.

Station Construction—The seven pumping stations were all practically alike. The layout in Fig. 13 gives an idea of the buildings and works necessary while Fig. 14 gives a plan of the pumping station building. The pumping station buildings are a steel-frame portable type, with corrugated iron sides. The foundations for the buildings and the machinery bases are of mass concrete, the engine and pump bases being poured monolithic so as to secure equal settlement. A fire wall is used between the oil engine and pump room as a protection against firing the oil in the pumps or the line.

The residences are of permanent construction, although they are designed to be torn down with a minimum of loss. Each station has a water system and a sewage system. The water system consists of wells pumping to steel standpipes about 34 ft. high and 15 ft. in diameter. The sewage system of cement joint vitrified clay pipe drains to a concrete septic tank.

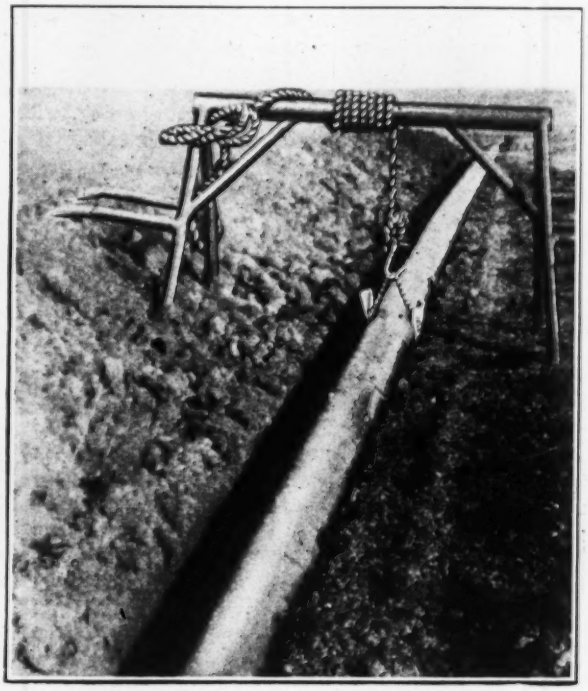


FIG. 11—LOWERING PIPE INTO DITCH
A belt sling is used in order not to damage the protective coating.

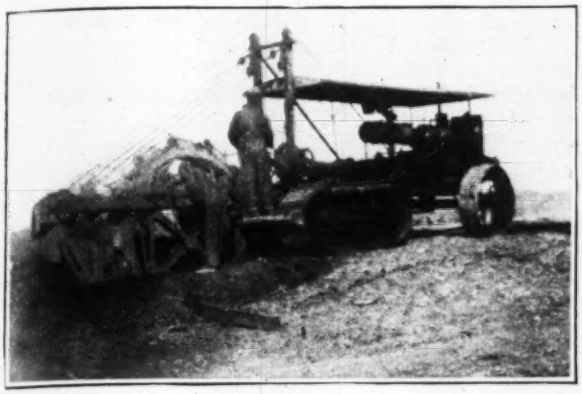


FIG. 12—DITCHING MACHINE DIGGING DITCH 42 IN. DEEP ALONGSIDE THE COMPLETED LINE

Placing a River Crossing—The most difficult single piece of construction occurred where the pipe line crosses the north fork of the Red River between Blair and Snyder, Okla. At this point the river bed is 4,800 ft. wide; the actual stream channel at present is slightly less than 200 ft. and practically in the center of the river bed. The material is quicksand and water is very near the surface for the entire 4,800 ft. In order to eliminate any possibility of catching driftwood, it was necessary to bury the pipe below the stream bed. Taking care of the water in the quicksand during ditching operations and burying the pipe in the actual stream channel were the major problems.

Two schemes were considered. The first contemplated

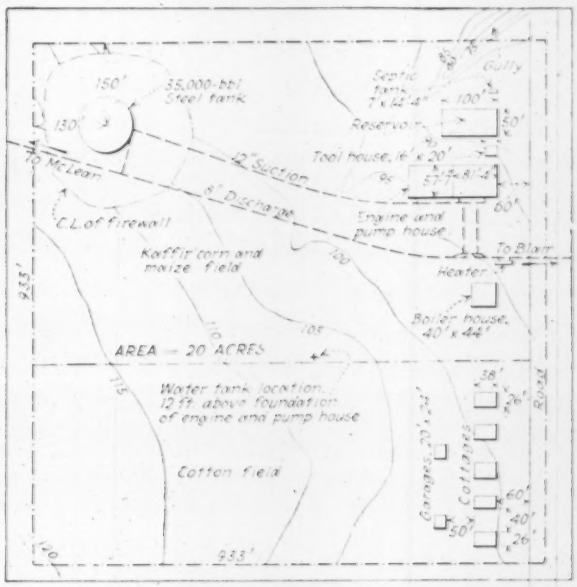


FIG. 13—AUXILIARY BUILDINGS AND STRUCTURES AT VINSON—TYPICAL PUMPING STATION ALONG LINE

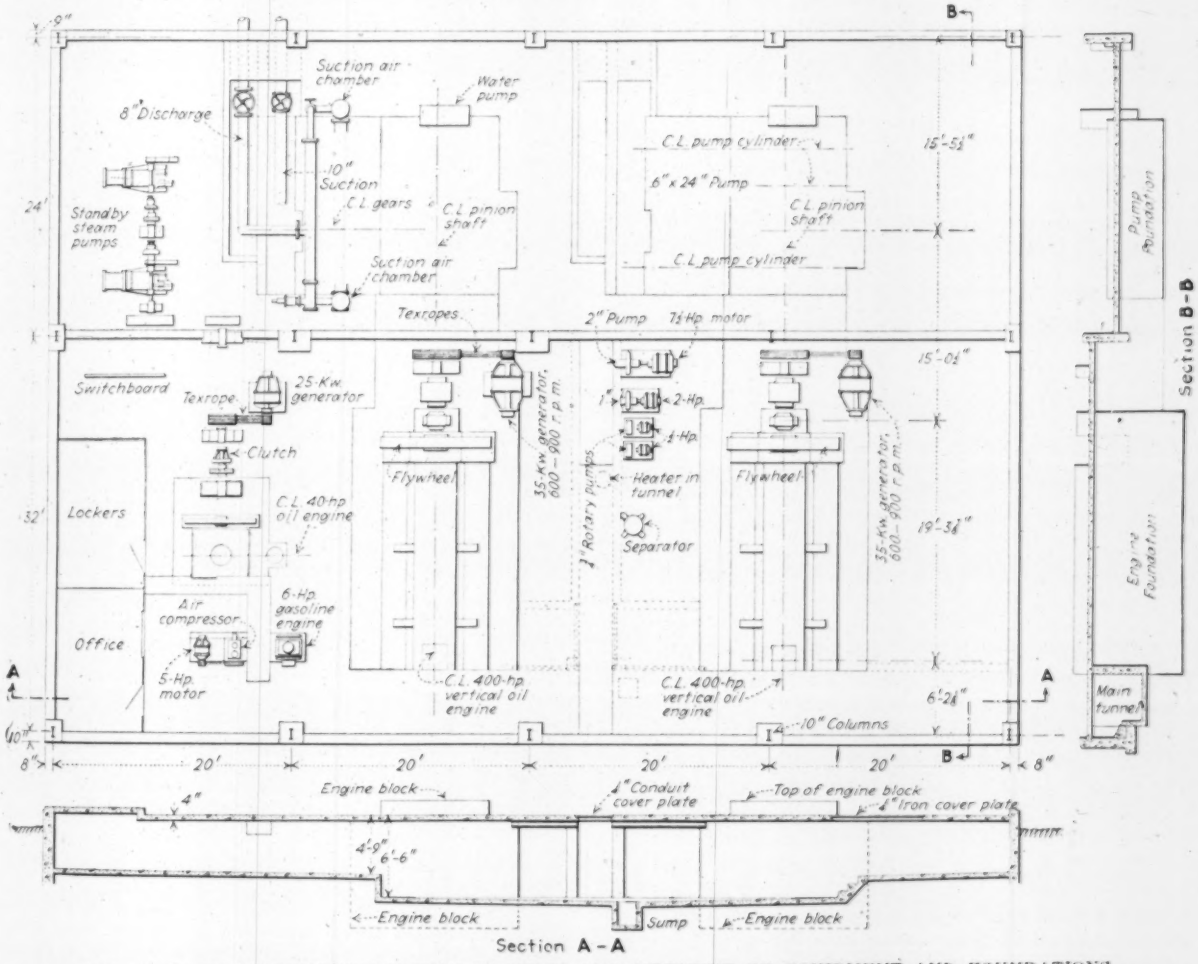


FIG. 14—PLAN OF PUMPING STATION SHOWING ARRANGEMENT OF EQUIPMENT AND FOUNDATIONS

ditching up to the stream channel, laying the line and then diverting the stream, by means of a temporary sand-bag dam, into one of the old channels flowing over the completed pipe line. Ditching could then continue over the present dewatered stream bed. The proposed temporary sand-bag diversion dam is shown on the map in Fig. 17. This plan was abandoned for two reasons. In the first place, sudden floods such as are quite common, would wash out the temporary diversion dam and all of the construction equipment. The second reason for discarding this scheme was the liability of trouble with the land owners along the river. The property line and in this case the county line is always in the center of the stream no matter in what part of the river bed it may be located. Changing the stream bed would therefore move the property line temporarily and in case of flood an entirely new channel might be cut, resulting in the loss of considerable "land" by one of the riparian owners.

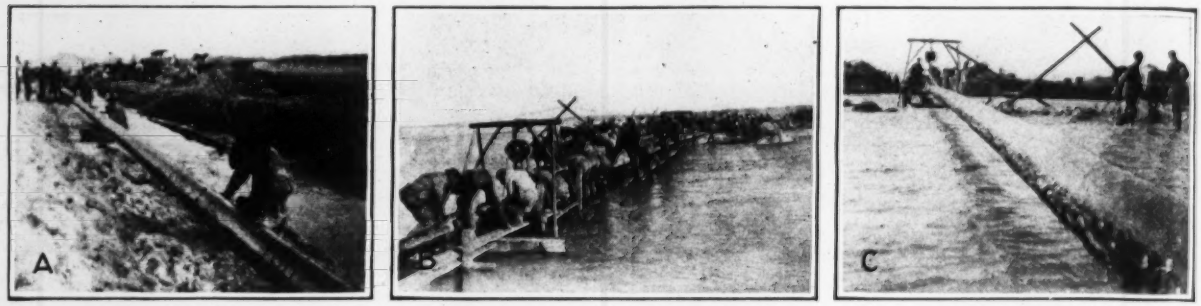


FIG. 15—CONSTRUCTING THE PIPE LINE ACROSS THE NORTH FORK OF THE RED RIVER

A—Placing the wire around the complete pipe on the river approach. Note that there is considerable water in the excavated ditch.

B—The pipe was lined, welded and coated on wooden trestles. A-frames of welded pipe and differential pulleys handled the pipe, as shown.

C—Large A-frame and pulleys handled the pipe while the trestles were being removed and later lowered the pipe into the stream bed.

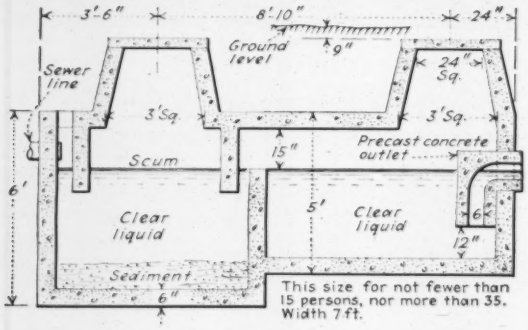


FIG. 16—DETAIL OF SEPTIC TANKS USED AT PUMPING STATIONS

The second and adopted procedure was to ditch up to the stream bed, drive wooden trestle bents for supporting the pipe, and to string and weld the pipe on this trestle. The water was only about 2 ft. deep so that the trestle building was not difficult. The pipe line across the channel is curved upstream so as to provide plenty of slack and to offer a better resistance against the current. After welding, the line was lowered into the water, no ditching being done along this 200 ft. It is hoped that the water will undermine the pipe so that it will bury itself. This theory is based on the noticed action of the sand wherever a piece of driftwood has lodged. The water forms eddies in going over the wood, resulting in a sort of an upstream undertow which leaves a considerable hole on the downstream side of the driftwood. This same action may result with the pipe line, so that a natural ditch will be formed.

If this action does not result within three or four months, it is planned to jet the sand from under the pipe. The proposed jetting plan contemplates using a 2-in. pipe perforated with ¾-in. holes every 5 or 6 in. This will be laid alongside the pipe line and a portable high pressure pump attached to each end. A jetting pressure of 1,200 lb. can thus be obtained for scouring a ditch beneath the pipe line.

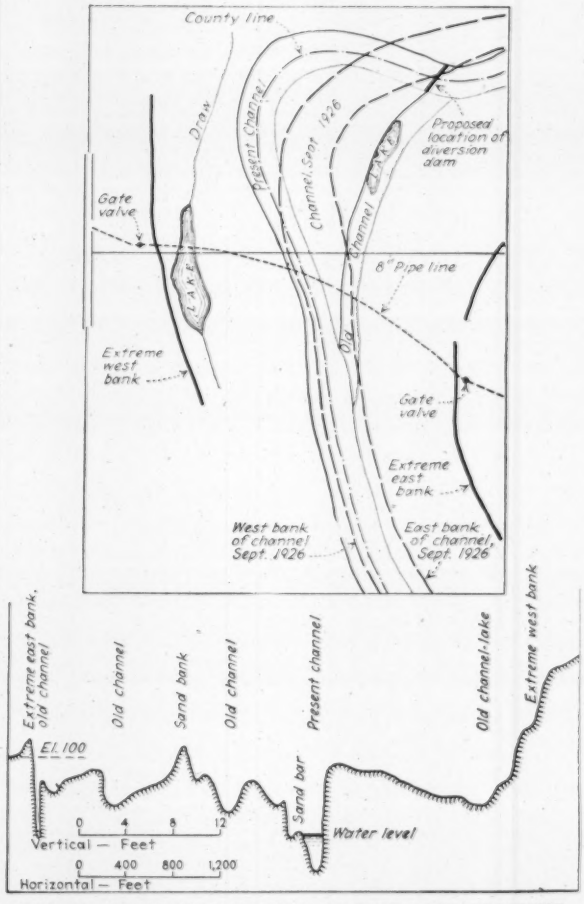


FIG. 17—PLAN AND PROFILE OF PIPE LINE CROSSING OF NORTH FORK OF RED RIVER

Handling the water while ditching the quicksand in the river bed was a major problem. A unit length of ditch 150 to 200 ft. long was opened and sloped both ways toward a sump in the middle. Gasoline-driven centrifugal pumps, one 4 in. and one 6 in., were used to dewater each opened section of ditch. In Fig. 18 one of these pumps is located on the right bank of the ditch. Trouble was experienced by the clogging of the foot valves at very inopportune times. A U-shaped connection, made up of welded pipe, was therefore devised to fasten to the suction side of the pumps. A valve was placed on each open end of the U and below this two lengths of hose and two foot valves were fastened. The valve on one suction line was kept closed until the other clogged. The latter was then shut off and cleaned while the pump operated through the other suction line. This worked very satisfactorily and gave uninterrupted service on the pumps.

All ditching was done with teams and slips. The trestle bents, consisting of 2x6 legs and a 2x12 crosspiece, were driven by hand with sledge hammers. A slight penetration into the quicksand held the bents quite rigidly. The pipe was lined up on the trestle and

FIG. 18—THE APPROACH TO THE RIVER CROSSING AND THE CONSTRUCTION FORCE
On the right bank of the ditch is shown the centrifugal pump used for dewatering the quicksand

welded much as it would have been on the ground. The welding equipment was carried on a barge alongside. The welded joints on the river crossing were reinforced by three pieces of strip steel 5 in. long, welded across the joint at 120-deg. intervals. The pipe was insulated and waterproofed in the same way as on land. A-frames and differential pulleys were used to raise the pipe from the trestle in order to apply the coating better, and were also used to lower the pipe into the stream.

Personnel—All engineering design and supervision and all cleaning and welding work were done by the forces of the Prairie Pipe Line Co. The pipe stringing contract was handled by J. L. Cox, Yates Center, Kansas. All ditching and backfilling were done by E. A. McPherson, Ft. Worth, Tex. The Standard Asbestos Mfg. & Insulating Co., Kansas City, Mo., supplied the materials and applied the protective coating. C. R. Weidner is chief engineer of the Prairie Pipe Line Co., and R. L. Jaeger is designing engineer. R. J. Tibbetts is field engineer in charge of all work. D. F. Phelps is construction foreman and T. R. Lott, superintendent of the southern division in which the line is being built.

Co-ordination of Local Technical Organizations

IN CITIES having several local technical organizations, efforts are often made to co-ordinate their activities for mutual benefit and for greater power in representing professional interests in public affairs. An example of such a movement is the Joint Council of the Associated Societies of St. Louis, which at present includes the engineers' club and the local sections of the six national societies of civil, mechanical, electrical, mining, refrigerating, and heating and ventilating engineers. A recent regulation states that the object of the joint council is: "To further the public welfare wherever technical and engineering knowledge and experience are involved; to provide co-operation among the engineering societies of St. Louis, and to consider and act upon matters of common concern to the engineering and allied technical professions."

Any local society or local section of a national technical organization, which is not organized for commercial purposes, is eligible for membership and may be admitted by a favorable vote of 75 per cent of the council, by letter ballot. The council is composed of the president or chairman of each local organization and two members chosen by each such organization. A president, vice-president and secretary-treasurer are elected and the president appoints three standing committees, on public affairs, publicity and joint meetings. The first of these reports to the council on legislative and other matters referred to it. All statements to the public are given out through the second committee, after approval by the council. A budget of estimated expenses is made annually and the amount is prorated among the societies on the basis of membership, but not exceeding 10c. per month. The regulations provide that:

The council shall have jurisdiction over all matters of joint interest to member societies and over matters of public welfare or public interest, and the member-societies shall act on all such matters only through the council. Such matters shall be referred to the council at any meeting or in writing to the president of the council, immediately after which a call shall be issued for a meeting to consider the matter in question and stating the object of the meeting. A quorum for the consideration of such matters shall consist of two-thirds of the total number of councilors representing at least 80 per cent of the member societies. A three-fourths vote of those present is required.

Doubledecking the Havre de Grace Highway Bridge

Railroad Crossing Built Half Century Ago Enlarged for Highway Traffic—Connections of Bracing Welded

By John N. Mackall
Chairman and Chief Engineer, State Roads Commission, Baltimore, Md.

RECONSTRUCTION of the well-known Harve de Grace bridge across the Susquehanna River, on the main highway route from Philadelphia to Baltimore and Washington, is now in progress. The bridge is being increased in traffic capacity by the addition of a second deck, to carry on each deck one-way traffic only. The history of this development is interesting.

The Havre de Grace highway bridge was built by the Pennsylvania R.R. as a single-track railroad bridge in the year 1873. In 1908, the railroad built a double-track structure at this point and offered the present bridge to the commissioners of Harford and Cecil Counties, between which counties the bridge runs, for a highway bridge, the new floor and draw to be provided by the county commissioners. At this time very little automobile traffic had developed, and few people even began to realize the traffic which would develop. The counties refused to accept the bridge from the railroad company. At its own expense, then, the railroad company provided a floor for highway traffic and a draw span, and gave the bridge to a group of seven citizens of Harford and Cecil Counties, who operated it as a toll bridge until February, 1923. The cost to the owners was nothing. They each put in $100 as working capital and began the operation of the toll bridge.

The State Roads Commission purchased the bridge under authority from the legislature on Feb. 12, 1923, for $585,000. The tolls were continued until the bridge was paid for. This $585,000, plus interest on the outstanding bonds, was completely earned on Sept. 30, 1926, when the receipts, after deducting the cost of operation and maintenance, amounted to $685,000. The toll rates were 60c. for each automobile, including the driver, and 5c. for each additional passenger. Higher rates prevailed for motor trucks and very low commutation rates prevailed for daily and monthly users.

The bridge was 13.1 ft. wide between wheelguards, which gave sufficient width with very careful operation of two lines of pleasure automobiles, but not enough for an automobile to pass a truck, or, of course, for two trucks to pass each other. The new draw span provided 22 ft. width. It became necessary to direct traffic so as not to allow vehicles which could not pass to meet on the bridge. Traffic became much too large for this to be done. The annual traffic over the bridge was 275,000 vehicles and the maximum daily traffic on Sundays and holidays reached 4,500. Obviously there was necessity for providing greater traffic facilities.

The act providing for the acquisition of the bridge specified that the tolls should continue until the bridge was completely paid for, after first deducting the cost of maintenance and operation. The State Roads Commission decided that "maintenance" included the cost of making the bridge satisfactory for travel, and consequently decided to continue the tolls for sufficient time to pay for the cost of making the bridge of a width adequate and safe for travel.

A number of schemes for doing this were considered and gradually eliminated. The first was the spreading of the trusses in providing for two lines of traffic. Because of the nature of the trusses, this was discarded as impractical. The next scheme considered was placing an additional driveway outside of each of the trusses. The bridge was amply strong for this, and for a while it seemed to be the most feasible proposition. However, the difficulties at the draw span were such as to make it necessary to discard this plan. Either the trusses of the span approaching the draw span would have to be splayed so as to make it wide enough for two lines of vehicles approaching the draw, or additional driveways would have to be put outside of the draw span, as was done on the fixed span. The width of the draw opening was not sufficient to permit the narrowing of the channel opening by the amount of additional width on the draw span. Splaying of the trusses would have very definitely complicated the movement of traffic and pedestrians, and, in addition, would have required the complete rebuilding of each of the spans next to the draw.

When these plans were all discarded, the only remaining alternative was to place one driveway above the other and to build the necessary approach spans. The trusses were amply strong to support the additional deck, and sufficiently high for the two clearance heights of 12½ ft. A new walkway 3 ft. 4 in. wide was placed on the south side of the bridge. The approaches are

FIG. 1—HAVRE DE GRACE BRIDGE WITH SECOND DECK NEARING COMPLETION

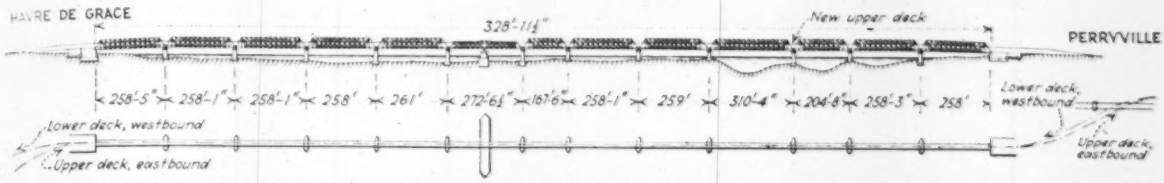
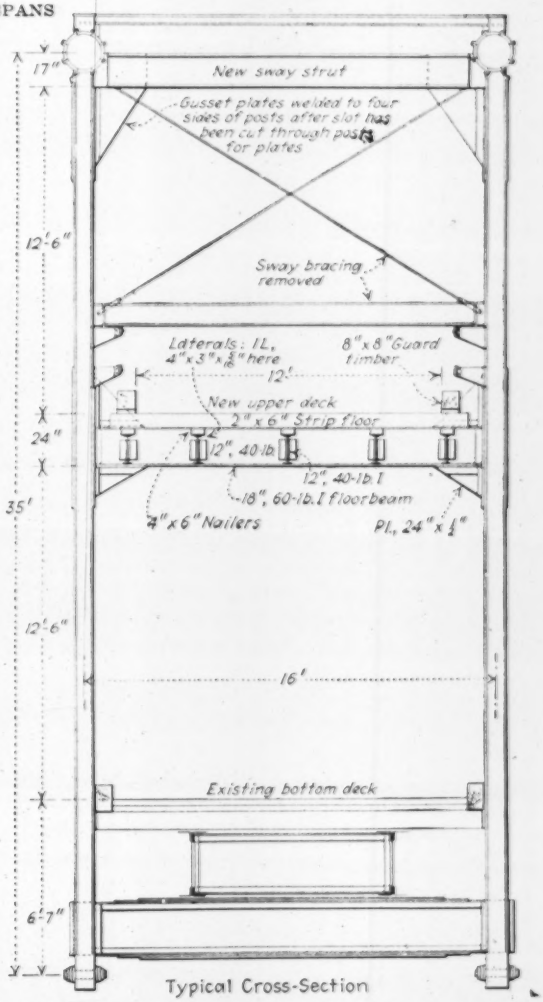


FIG. 4—RECONSTRUCTION OF ONE OF THE FIXED SPANS OF HAVRE DE GRACE BRIDGE

so arrenged that traffic coming in on the right of the road will automatically take the driveway which will lead to the upper or lower deck as required, and it seems that no difficulties in operation will be encountered.

FIGS. 2 AND 3—FRAMING OF UPPER DECK, AND WELDER AT WORK

The old trusses have compression members of wrought-iron Phoenix type, some of them made of four, some of six and some of eight sections. The sway



Typical Cross-Section

bracing near the top was all removed, and a new sway strut was placed over the top of the upper driveway; this with the floorbeams midway the trusses provided for ample stability and rigidity.

The new sway strut and new floorbeams are being welded to the existing columns. This is accomplished by slotting the vertical columns sufficiently long to place through them a gusset plate strong enough to support the beams and struts. Then this gusset plate is welded to the vertical column on both sides. Tests made on this form of welding demonstrate that it is as satisfactory as riveting and considerably more economical and expedites the work materially.

Laminated wood floors are used on both decks. Concrete was considered, but discarded because of the weight which it imposed upon the structure.

In order to make the approach to the upper deck fit into the surrounding conditions as well as possible each of the end spans was lowered at the abutment 7.5 ft., making a grade of 3 per cent on each of the end spans. It was necessary to strengthen the trusses of the draw

span to carry the additional weight and this was done by bolting additional sections to the trusses. The old draw span was operated by gasoline motors, and in the new construction, because of the additional weight, electrical motors were installed for operation.

The overall length of the bridge is 3,282 ft., and the height above the water is 31 ft. The depth of foundation is 35 ft. from water surface to top of grillage. All the piers are first-class cut stone masonry to solid foundation.

Providing the bridge with two 12-ft. roadways in this manner and building the approach spans will cost approximately $300,000. The tolls will net this amount in about one year. After sufficient money has been collected from the tolls to pay for the widening and reconstruction, the bridge will be made free of toll. The commission feels that the most satisfactory solution which could have been obtained has been obtained, and that it is provided with a bridge which will satisfactorily carry the traffic over peak loads at only a fraction of the cost of replacing the bridge with a new one.

Earth-Filled Dam Leakage Stopped by Grouting with Cement

Leakage Through a Dam of the Modesto Irrigation District Stopped by Cement Grout When Reservoir Was Half Full

By W. H. Holmes
Irrigation Engineer, Modesto Irrigation District, Modesto, Calif.

Grouting of seams in rock to stop the flow of water is a common procedure, but its application to sand and clay has not been extensive, consequently the results obtained in stopping flow through an earth-fill dam of the Dallas-Warner reservoir of the Modesto Irrigation District, Stanislaus County, Calif., is of note.

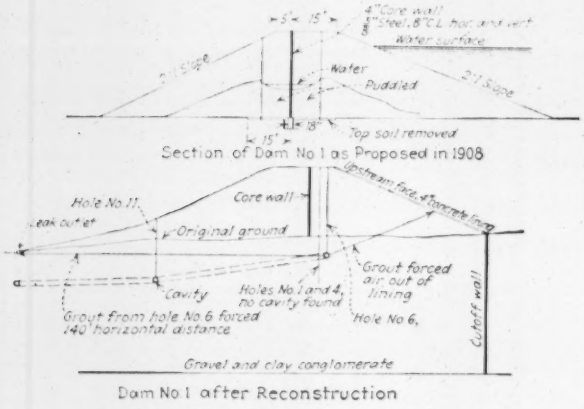

Section of Dam No. 1 as Proposed in 1908
Hole No. 11
Leak outlet
Core wall
Original ground
Cavity
Holes No. 1 and 4, no cavity found
Hole No. 6,
Grout from hole No. 6 forced 140' horizontal distance
Grout forced air out of lining
Cutoff wall
Gravel and clay conglomerate
Dam No. 1 after Reconstruction

FIG. 1—SECTIONS OF THE DALLAS-WARNER RESERVOIR DAM
The lower section shows the concrete lining and curtain wall built in 1915-16, also progress of grouting operation.

Construction of Dam No. 1, the largest of six dams forming a reservoir of 27,000 acre-ft. capacity, was begun in 1909. The dam is of earth fill with a concrete core-wall and puddled core, 1,600 ft. long and 32 ft. high through the maximum section. When first constructed, this reservoir was the supply for summer irrigation of 50,000 acres. As the district grew, however, Don Pedro dam was built on the Toulumne River in conjunction with the Turlock Irrigation District, leaving the Dallas-Warner reservoir mostly as an afterbay for regulation of the irrigation demand.

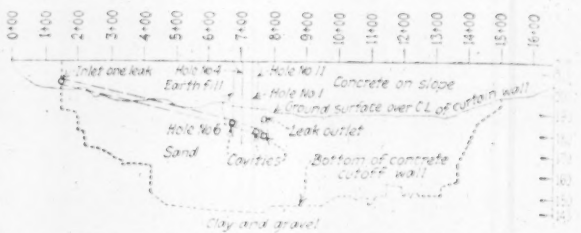


FIG. 2—LONGITUDINAL PROFILE OF THE DAM

Signs of Trouble—The Dallas-Warner reservoir was half full of water last fall when the seepage of some 2 sec.-ft. began to show on the downstream face. This

FIG. 3—FLOW FROM RESERVOIR UNDER CUTOFF TRENCH AT END OF LINING

seepage, being concentrated at one opening, had possibilities of becoming dangerous to the whole structure if erosion started.

The original plans for the dam show a 20-ft. crest, an upstream slope of 2½ to 1, a downstream slope of 2 to 1, and a freeboard of 5 ft. A 4-in. concrete core-wall was to have been built 5 ft. from the downstream edge of the crest with an 18-in. base carried down to hardpan or clay. A section of 10 ft. on each side of the core-wall was to have been puddled during construction. The details are given in Fig. 1. Old employees of the district stated that the core-wall was built on top of the soil, not even removing the grass, and that the puddling was carelessly done. During construction a part of the core wall fell over, from excessive puddling on one side.

When water was first turned into the reservoir in

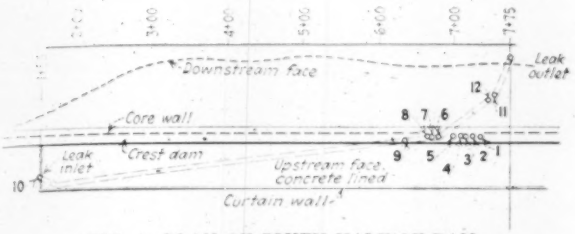


FIG. 4—PLAN OF SOUTH HALF OF DAM
Showing location of inlet and outlet of leak, also grout holes.

1911 a large leakage developed near the maximum cross-section. Water flowed through the dam in a hole stated to have been some 2 ft. in diameter. Subsequently, a section of the dam suddenly settled and stopped the flow. Sheetpiling later was driven beside the core wall but some seepage continued.

Investigation of the dam site to determine the cause of the trouble was started in 1914. Test wells showed a layer of white sand as much as 40 ft. thick under portions of the dam. As its failure would have caused considerable damage to land in the vicinity and would have deprived 50,000 acres of irrigated land of a July or August irrigation, it was necessary to make the dam safe at any cost.

The repair plan adopted was to line the upstream face with 4 in. of reinforced concrete, also, to build a cutoff wall from the intersection of the lining and the original ground down to the clay and gravel conglomerate below the sand bed. A profile of the dam showing crest, original ground surface, and bottom of cutoff wall as built is shown in Fig. 1.

Excavation of a trench for the cutoff wall 40 ft. deep and 1,000 ft. long through sand was a tedious task. The work was finished by 1917, but still the seepage continued. As a further measure, considerable soil was scraped on top of the lining with the expectation of stopping the leakage in the expansion and construction joints. This was effective for a short time.

In December 1926 water was entering under the concrete wall at station 1 + 53 or at the end of the face lining. The cutoff wall at the end of the lining was 3 ft. deep. A small earth dam was placed around the leak and an excavation was made. It was found that water was going under the cutoff wall and back to the lining, as shown in Fig. 3. Fifteen minutes after 1 sec.-ft. of muddy water was allowed to enter this hole the seepage from a hole on the lower side of the dam 650 ft. distant, suddenly increased in flow and became muddy. This indicated a small cavity entirely through the dam. The continuation of outflow when water was not flowing in at station 1 + 53 indicated that there were one or more openings or channels in addition to the known channel. The problem was to locate and block all these channels or cavities.

Soundings were made with a water jet drill to locate the cavities. Iron pipe ¾ in. in diameter was used to drill the test holes. A ¾-in. hose connected to a force pump supplied the water to wash the fine soil to the surface quickly as the pipe was lowered. When a cavity or channel was found the flow from around the pipe ceased and in several instances the seeping water became muddy, indicating that the channel or channels were found. Pipes 2-in. in diameter were placed in the test holes that showed cavities and cement grout was poured in. After the grout ceased to flow by gravity, pressure was applied and the grout was forced into all cavities. While grouting hole 6 (Fig. 1) cement flowed out the leak and also air bubbles were showing below the water surface in the construction joints of the upstream face lining. Grouting was continued until cement showed on the ground in a 20-ft. circle around the hole. Hole 11 was first drilled (see Fig. 4), and as a cavity was found the probable direction of the flow was shown. Holes 1, 2, 3 and 4 were made, but no cavity was found. Holes 5, 6, 7, 8 and 9 were drilled and cavities were found. When hole 6 was filled about one-fourth of the original leakage stopped. When hole 10 was plugged three-fourths of the leakage was stopped. Holes 7, 8 and 9 had very little effect on the flow.

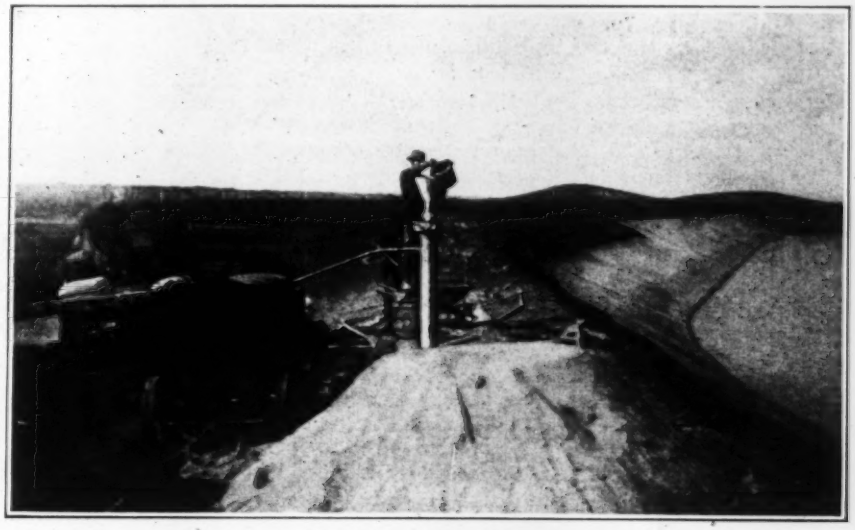


FIG. 5—GROUTING DAM TO STOP LEAKS
Three grout pipes are shown, together with grouting machine. Note soil scraped onto upper part of lining to stop seepage.

The holes ranged from 12 to 40 ft. deep, the majority being over 28 ft.; 149 sacks of cement were used.

As the remaining leakage was coming from under an 8-ft. ledge of hardpan it was decided to grout under the ledge. Holes 11 and 12 were on the downstream side of the dam and extended below the ledge of hardpan. When these holes were grouted all seepage stopped and has not reappeared.

With 1 sec.-ft. of water requiring 15 minutes to fill the channel and flow through the dam, it was estimated that it would require 15 times 60, or 900 cu.ft. of material to fill the cavities.

Sand was mixed with the cement several different times but each time the grout machine would plug even with application of 150 lb. of air pressure.

The grouting was done at a cost of $400 as compared with $85,000 for the curtain wall and lining which were not effective in stopping the seepage.

Depreciation Becomes of Greater Importance to Railroads

Work of Valuation Engineers Comes Into Prominence by Recent Order of Interstate Commerce Commission

By Henry J. Saunders
Bureau of Valuation, Interstate Commerce Commission, Washington, D. C.

THE year 1926 was one of great operating efficiency on the part of the railroads. This status was definitely indicated by increased car loadings, lower operating costs and several other factors which made it one of the most prosperous years in railroad history.

It was but natural, therefore, that when the Interstate Commerce Commission on Nov. 2, 1926, issued an accounting order, known as 15100, relative to the setting up of depreciation charges, railroad executives, security holders, and certain writers for financial journals should immediately question the effect of this order upon the financial statements of the carriers.

Briefly, this order provides that each carrier shall file with the commission not later than Sept. 1, 1927, estimates of the composite rates of depreciation which it proposes to apply to the ledger value of each of the separate primary accounts. [The primary accounts are uniform ones which each railroad is required to keep for reporting its financial status to the commission.] After the commission has tentatively approved the application of the composite rates of depreciation submitted by the carriers, the order further provides that not later than Jan. 1, 1928, the various carriers shall accomplish a redistribution of their investment accounts, this redistribution being for the purpose of determining amounts assignable to the depreciable accounts. In order to accomplish this rather complicated determination of base to which depreciation rates are to be applied, the commission indicated that four steps should be followed:

(1) The determination of total quantities of property installed subsequent to June 30, 1914, but prior to the carrier's official valuation date under the Valuation Act.

(2) The deduction of these quantities from the engineering report covering the estimates of cost of reproduction new at the June 30, 1914, prices contained therein.

(3) The addition of these quantities to the previously adjusted 1914 base at prices representing the actual cost of these items of property at date of installation.

(4) The addition of quantities and costs recorded for property installed subsequent to the carrier's official valuation date.

Having determined this adjusted sum for each of the primary accounts, the total of all the accounts must then be deducted from the original recorded investment account of each carrier and the difference, if any, must then be carried in the accounts as an unadjusted item. Judging from this finding of the commission it is apparent that the work done by the valuation departments of the carriers and the commission's bureau of valuation is of prime importance in determining these adjusted ledger accounts.

Specific provision is made for the use of the data available as obtained by these valuation departments; and where agreements have been reached between the bureau of valuation and the carriers, the figures so determined are to be substituted for those appearing in the original inventory.

The matter of extraordinary repairs is treated in the order of the commission and provision is made for the crediting to investment account of a proportionate part of the total ledger value of the structure or piece of property under repair. It is apparent from the order that a reasonable distribution of the carrier's investment account is contemplated so that the previously prescribed rates of depreciation may be applied to produce a reasonable depreciation reserve for each of the separate accounts.

Depreciation as a Liability—The one feature of the order referred to, by financial writers, as disquieting is that which provides that not later than Jan. 1, 1928, each railroad company shall estimate, in accordance with the principles determined for developing current depreciation, the amount of past accrued depreciation upon those accounts which are considered as depreciable. This estimated amount of accrued depreciation will then appear on the liability side of each carrier's balance sheet and will be designated in the same manner as the reserves for depreciation set up prior to the issuance of this order 15100. In the carrier's accounting it is provided that this assumed accrued depreciation shall appear as a credit to the depreciation reserve and shall be concurrently debited to a suspense account on the asset side of the balance sheet. The latter provision is thus a stabilizer and should in no way affect the finances of the company. The danger feared in certain quarters is thus removed and the carrier's surplus is neither materially reduced, entirely wiped out, or made a net loss. The finding of the commission as to this accounting is self-explanatory:

> "This suspense account could then be gradually extinguished by charges to profit and loss over a maximum period of years or in such shorter time as the carriers might elect."

In effect, therefore, although an estimated accrued depreciation reserve has been established by a single entry, there is no intention to convert surplus or profits into losses which will impair credit. Thus, a railroad which has been upon an operating basis permitting the payment of substantial dividends, will under this system of accounting find itself in exactly the same position financially as it was prior to the issuance of the order.

During each of the years following the establishment of the depreciation reserves, the amounts formerly charged directly to operating expenses will be carried as credits to the depreciation reserve and the accrued depreciation determined upon for the year will represent the direct charge to operating expenses. There may thus be certain discrepancies in a single year but the effect over a considerable period will be uniform.

Amount of the Depreciation Reserves—Prior to the issuance of this order the carriers were required to set up depreciation reserves covering their equipment accounts and in many instances these reserves were of considerable magnitude. They were permitted also, to set up depreciation reserves in certain other accounts, and as shown in appendix F of order 15100, certain carriers have taken advantage of the provisions in the accounting classification and have set up reserves on

particular items of property, such as special bridges, coal and ore wharves, buildings, and special structures. The amount of this depreciation reserve with relation to the total investment accounts of the steam railroads is shown in appendix C. On the average it is less than 10 per cent of the total of such account.

On the other hand, in appendix D of the order is shown the ratio of the reserve for accrued depreciation on equipment to the total investment in such equipment, and it is found that the ratio in 1923 averages between 30 and 40 per cent. For the Class 1 railroads, including lessors and the switching and terminal companies, in the year 1924 the accrued depreciation reserves total $1,521,059,295 or something over 7 per cent of the net book value of these same carriers.

Extent of Depreciation—The importance of the depreciation element may be illustrated in another way by taking some 84 of the principal railroads of the United States with a total of 162,220 miles of main track and 251,071 miles of all tracks or about two-thirds of the railroad mileage of the country. The engineering reports of the bureau of valuation on these properties show a ratio between the cost of reproduction new and cost of reproduction less depreciation of 78.6 per cent, the depreciation representing $2,327,307,532. An examination of the accounts in detail shows just where the largest portion of this depreciation occurs. First, considering the three main subdivisions we find:

	Per Cent Depreciated	Depreciation	Per Cent of Total Depreciation
Road	17.3	$1,246,985,266	53.6
Equipment	32.7	934,375,365	40.1
General expenditures	17.8	145,946,901	6.3
Total	21.4	$2,327,307,532	100.0

The cost of reproduction new of these three divisions in percentage is:

	Per Cent
Road	66.3
Equipment	26.2
General expenditures	7.5
	100.0

We find, for instance, that 26.2 per cent of the costs carry 40.1 per cent of the depreciation.

Of the road accounts, which are numbered 1 to 47, the following table shows those of most importance and the percentage of depreciation in each:

Account		Per Cent of Total Road Accounts 1 to 47	Depreciation	Per Cent of Cost New	Per Cent of Total Depreciation Accts. 1-47
3	Grading	30.9	$22,226,118	1.2	1.8
6	Bridges trestles and culverts	12.4	181,991,614	19.8	14.7
8	Ties	5.4	257,778,712	44.3	20.7
9	Rail	13.0	120,938,139	13.5	9.7
10	Other track material	3.8	86,907,887	30.7	7.0
11	Ballast	5.7	106,903,389	23.8	8.5
12	Tracklaying and surfacing	5.8	121,225,272	25.9	9.7
16	Station and office buildings	4.8	92,764,759	24.6	7.4
	Total	81.8	$990,735,890		79.7
Total depreciation, accts. 1 to 47			$1,246,985,266		

From this table it is evident that practically 80 per cent of the total depreciation recorded under "Road" is in the eight accounts which represent 81.2 per cent of the costs of accounts 1 to 47.

Effect on Valuation Work—The depreciation order is an accounting matter and apparently designed to stabilize the carrier's accounting methods, but it is so dependent upon the valuations as determined by the commission that some discussion of these methods may seem necessary. Accrued depreciation from an accounting standpoint may or may not represent physical depreciation from an engineering standpoint.

Under the Valuation Act the commission was instructed to determine the cost of reproduction new and the cost of reproduction less depreciation. These estimated costs of the property were to be reported separately from the value of the property, and it is clear that the commission is required to set up costs and value separately. The costs are to be set up on the basis of the commission's classification of accounts, and being *property costs* should not contain any of the elements of *property or business value*, including going concern, development cost, appreciation and other intangibles. Cost less depreciation, therefore, as determined by the bureau of valuation of the commission, is intended to cover the actual physical depreciation of the property determined by field inspection.

To assist in determining proper depreciation, the engineering board of the bureau of valuation compiled a memorandum known as board memorandum 226, which sets up in detail the normal service lives of various elements of property and gives certain rules to be followed in establishing service-condition per cent. The method followed is that known as the straight line method of computing depreciation and is the same as that approved by the commission in its order 15100. The results obtained by the bureau of valuation and by the accountants are, therefore, measurable on the same basis.

Many questions, such as salvage value, obsolescence, and abandonments, are discussed in order 15100; and with relation to obsolescence the order says that consideration of this element as a factor of depreciation must have the approval of the commission. In a concurring opinion in connection with this order, Commissioner Woodlock calls attention to the fact that certain items of depreciable property are not included in the order and questions the logic of this determination. The principal items not included by the commission include:

(1) A portion of property chargeable to the grading account, which is similar to property found under several other accounts.

(2) Tracklaying and surfacing, account 12, which is a labor account considered by the bureau of valuation as depreciating in the same ratio as the depreciation assigned to the materials in the track accounts.

(3) Roadway small tools, account 38, which has been depreciated in the bureau of valuation estimates.

(4) General expenditures, accounts 71 to 77, which are also considered as depreciable in the same ratio as the road accounts by the bureau of valuation.

This order of the commission is far reaching and the labor of putting it into active operation will be an item of considerable importance. However, after a few inevitable minor adjustments, it should prove very effective in stabilizing carriers' accounting. The valuation departments of the carriers and of the bureau of valuation will be called upon to render much assistance in furnishing the data necessary to comply with the order, and the importance of their work is emphasized when it is realized that the entire basis of the adjusted ledger accounts depends almost wholly upon the results of the work done by the valuation engineers.

[Since this article was written the effective dates of the commission's order have been postponed one year. —EDITOR.]

Developing a 10-M.G.D. Water Supply from Wells and Surface Sources

Amarillo, Tex., with a 300-Per Cent Population Increase in Five Years Goes 15 Miles for Well-Water—Impounding Reservoir for Emergency

THE OLD well water supply system of Amarillo, Tex., was designed for a city of about 15,000 population. It was thoroughly adequate in 1920. Today the city, as a result of natural growth and the oil field activity in the Texas Panhandle, has a population of nearly 50,000, about 35 per cent of which has been added in the past 18 months; and the old water system is still trying to supply the need. There is, however, nearing completion a new 10-m.g.d. supply of which 7 m.g.d. is to be taken from new wells and 3 m.g.d. in emergencies from a new impounding reservoir. Both the dam and wells are located about 15 miles from Amarillo on a ranch purchased by the city for water supply purposes. Water from the wells is pumped to a receiving reservoir, just below the dam, which can also be fed from the impounding reservoir. A pumping station near the receiving reservoir, with a suction line to the reservoir, delivers the well water and, in emergencies, the impounded supply, to a 15-mile pipe line which for the most part is under gravity head. At the city end of the pipe line there is a second receiving reservoir, from which water is pumped to an elevated tank. There are a number of surge tanks on the pipe line.

The old supply was pumped from 37 wells, located in various parts of the city, to a central elevated steel tank. The old works, with 150,000 ft. of distribution pipe, is privately owned but negotiations are under way for its purchase by the city before the new system, which will cost about $2,100,000, is completed. Construction of the new system has been in progress during the past winter and spring, and it is planned to deliver the new water into the mains by July 1. Partly because of this work, and partly because of the other municipal engineering occasioned by such rapid city growth, the city engineer now has a staff of 14 engineers and 20 inspectors, compared with 2 engineers and 2 inspectors a year ago.

Public sentiment in Amarillo was against the use of water from impounding reservoirs, so wells were adopted as the main new source of supply. Considerable prospecting located a suitable well supply about 15 miles southwest of the city, where 7 wells have now been drilled. Six of these are to be operated by air lift and one, which is close by the receiving reservoir, by a motor-driven axial flow pump. The wells are of the commercially known "air-made" type in which a large cavity made by compressed air around the perforated strainer pipe is filled with gravel fed in from the top. Before referring to the method of construction of these wells, the new project as a whole will be described.

Impounding Reservoir—The impounding dam is approximately 45 ft. high above the bed of Palo Duro Creek and has a crest length of 1,650 ft. It is composed largely of dry, sandy loam with select earth and riprap on the upstream side. It forms a reservoir 3½ miles long and ¾ mile wide. The overflow spillway, 550 ft. long, empties into the Negro Arroyo, a stream parallel to the one on which the reservoir is built, the two streams uniting just below the dam. The bottom of the overflow spillway is covered with 10 in. of riprap and a cutoff seal is placed at both the upper and lower ends. A 24-in. suction line runs through the dam from the gate house above to the pump house below the dam. The gate house is a reinforced-concrete cylinder 9 ft. in diameter and about 45 ft. high with four inlet ports distributed spirally around its circumference, 8 ft. apart vertically.

Two of the wells are located just below the dam and the other five above it and near either side of the reservoir. Their yield is pumped into a 0.5-m.g. receiving reservoir just below the dam. This reservoir may also be supplied from the impounding reservoir.

Receiving Reservoir—The receiving reservoir below the dam, which also serves as a pump well, is 65 ft. in diameter, and is constructed of reinforced concrete with a reinforced-concrete roof supported on columns. The structure is partly in excavation and will be completely covered with earth.

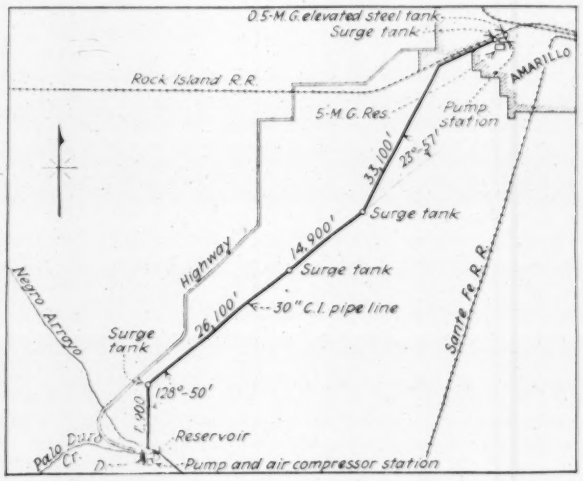


FIG. 1—AMARILLO'S NEW WATER SUPPLY SYSTEM

Supply Main—The entire 15.7 miles of the pipe line is of 30-in. cast-iron pipe, imported from France. As shown by Fig. 1, especially long tangents are used, one being close to 8 miles in length. At each major change in direction, as also in the center of the longest tangent and at the city end, reinforced-concrete surge tanks are provided. These tanks equalize the pressures along the pipe line, while the one at the city end serves, in addition, to keep the line full of water. Air relief valves are placed at all minor summits in the line, and special drain valves at the low points. Water from the receiving well is pumped to the first surge tank, which is about 115 ft. above the pump house and 1½ miles distant. From this surge tank the water flows some 14.6 miles by gravity to the city.

City End—Water is received at the city end of the pipe line in a 5-m.g. covered, concrete reservoir, from which it is pumped into a 0.5-m.g. elevated steel tank which provides the city pressure at a maximum of 67 lb. with an estimated possible friction drop of 8 lb. in any part of the city. About 78,000 ft. of 6- to 24-in. water mains are being laid in the city, of which some 60,000 ft. will reinforce the gridiron and cut out dead ends, and the remainder will be extensions.

Developing the Wells—The country west of Amarillo slopes upward toward the west and a careful study was made in that direction for a distance of about 100 miles, about 50 test holes being put down. The information thus secured determined that an adequate supply of water could be secured from the fine quicksand beds of the quaternary formations found at a depth of from 30 to 150 ft. below the surface at Palo Duro canyon, about 15 miles southwest of the city.

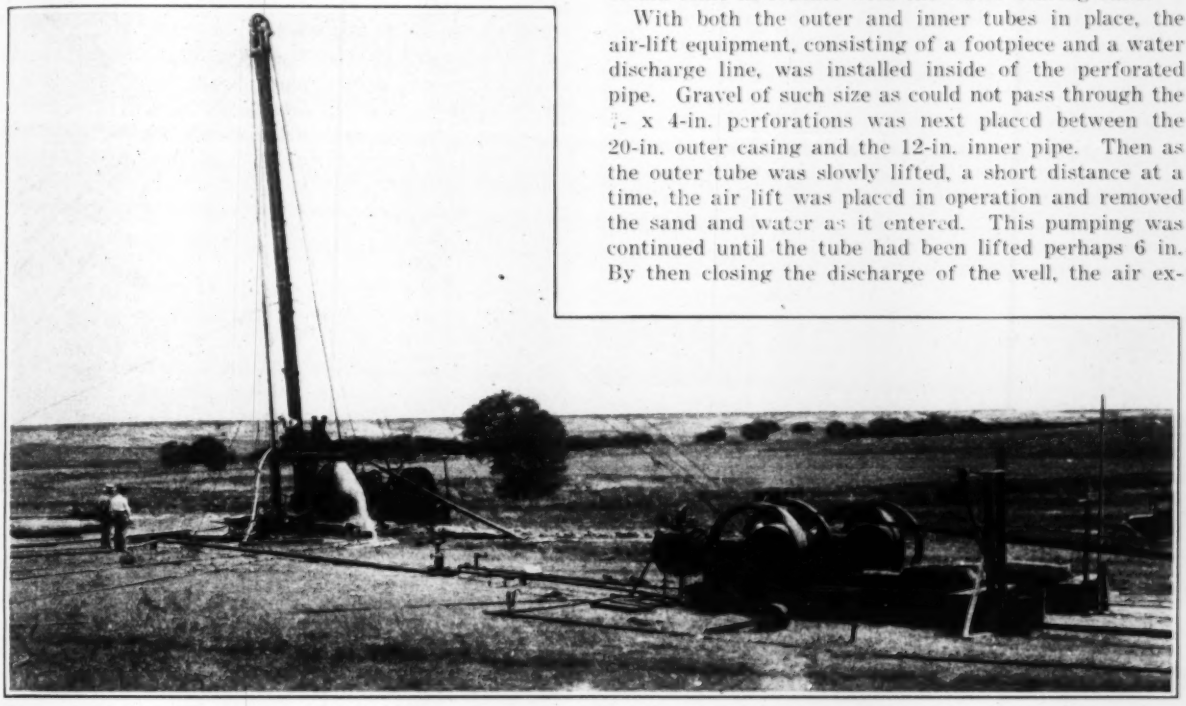


FIG. 2—WELL DRILLING RIG ON AMARILLO WATER-WORKS

The air compressors in the foreground are belt-driven from farm tractors. In the background is Palo Duro canyon which will form the impounding reservoir. The dam is at the left of the picture.

Water in this section is secured from beds of fine sand, ranging in thickness from 50 to 90 ft. Past experience had demonstrated a number of facts. Large dug wells sunk into these sand beds are not a permanent solution because the fine sands pack so tightly around the walls that the water will not flow into the wells at a sufficiently fast rate. Even tunnels from such wells are said to sand-pack. Drilled wells, using fine screens surrounded by a thin wall of gravel, experienced the same troubles as in the large dug wells, the fine sands soon cutting off the flow of water. The use of large screen openings on pumped wells permitted too much fine sand to be pumped out, causing not only wear on the pumps, but also leaving a cavity that ultimately caved in and shut off the water supply.

The contract finally was let for a type of well, known commercially as "air-made," which permits a large gravel deposit to be placed around the perforated screen in the cavity formed by back-blowing air into the well and pumping out the fine sand. Air-lift installations are used on six of the seven wells. In constructing the wells, a 20-in. screw joint oil-well casing was sunk through the sand formations to the impervious clay deposit below. This casing shut out all sand and water from the well, permitting the second operation to start. This consisted in extending a 12-in. wrought-iron screw-joint pipe into the clay below the water-producing strata. This pipe was placed to a proper depth to give sufficient submergence for the operation of the air-lift system and was perforated for at least 20 ft. where it would come in contact with the water-bearing sand.

With both the outer and inner tubes in place, the air-lift equipment, consisting of a footpiece and a water discharge line, was installed inside of the perforated pipe. Gravel of such size as could not pass through the ¾- x 4-in. perforations was next placed between the 20-in. outer casing and the 12-in. inner pipe. Then as the outer tube was slowly lifted, a short distance at a time, the air lift was placed in operation and removed the sand and water as it entered. This pumping was continued until the tube had been lifted perhaps 6 in. By then closing the discharge of the well, the air exerted a quick back pressure through the perforations into the water stratum. This pressure forced gravel under the 20-in. outer tube, filled any voids that were present, and at the same time agitated and loosened the fine sand in the water stratum. By a repetition of this process of pumping, back-blowing and raising the outside casing, from 100 to 165 cu.yd. of gravel was introduced into each well. The cleaning process was kept up until each well flowed at least 500 g.p.m., according to weir measurements. The well drilling rig is shown by Fig. 2.

A section of both the air-lift and motor-pumped well is shown in Fig. 3. The receiving tank around the top of the air-lift wells is octagonal in form and of reinforced concrete. A well constructed around the outside casing and extending to the concrete cover over the receiving tank is used as a gravel supply magazine. On the motor-operated well, the axial-flow pump has a capacity of 500 g.p.m. against a total lift of 90 ft. The well casing is 10 in. in diameter and the depth of the

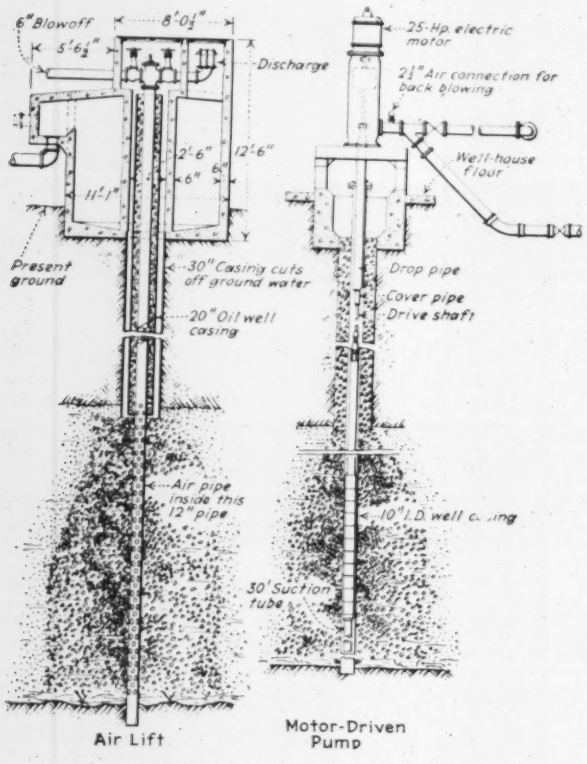


FIG. 3—TYPES OF WELLS USED ON AMARILLO WATER-WORKS

In the air-lift well, note the casing used as a gravel supply chamber and to cut off ground water.

well 146 ft. On test, the yield of this well was about 600 g.p.m. Provision is also made for back-blowing on this well when necessary. The air is carried down through the water eduction pipe. A well house and tower are erected on a concrete platform around the well.

Compressor and Pump House—The well and impounding reservoir pumping station (Fig. 4) contains the pumps, all compressor equipment, and the chlorinating equipment.

Two synchronous motor-driven centrifugal pumps, each of 4-m.g.d. capacity, are used for pumping the water from the storage reservoir into the first surge tank on the city discharge line. The pumps are horizontal-shaft, single-stage, double-suction volute pumps, with horizontal split casings. Two compound air compressors belt-connected to synchronous motors are used to supply air for the seven wells. Each compressor has a capacity of 900 cu.ft. of free air per minute. Two motor generator sets furnish 125-volt direct current for field excitation of all synchronous motors. Current is received from the city to run the exciter set which has sufficient capacity for the motors on both the pumping units and the compressors. The current received is 3-phase 60-cycle 13,000-volt alternating transformed at the station to 2,200 volts. For standby service, a high-speed gasoline-engine-driven electrical generator is installed. Outside of the building two air receivers, 3½ ft. in diameter and 8 ft. long, are installed.

Administration—All plans and designs were made by Wynkoop Kiersted, consulting engineer, Kansas City, Mo. H. B. Jones is city engineer of Amarillo, with Marvin Nichols as chief construction engineer. The work was done by various contractors. The wells were installed by P. S. Judy, of the Air-Made Well Co., Oklahoma City, agents for the Sullivan Machinery Co. The dam was built by Luck & Aldredge, Kansas City, Mo. The pipe line was laid by the Sherman Machine & Iron Works, Oklahoma City. The reservoir and pump house in the city were built by the Kimball Construction Co., Colorado Springs, Colo. The elevated steel tank in the city was furnished and erected by the Chicago Bridge & Iron Works.

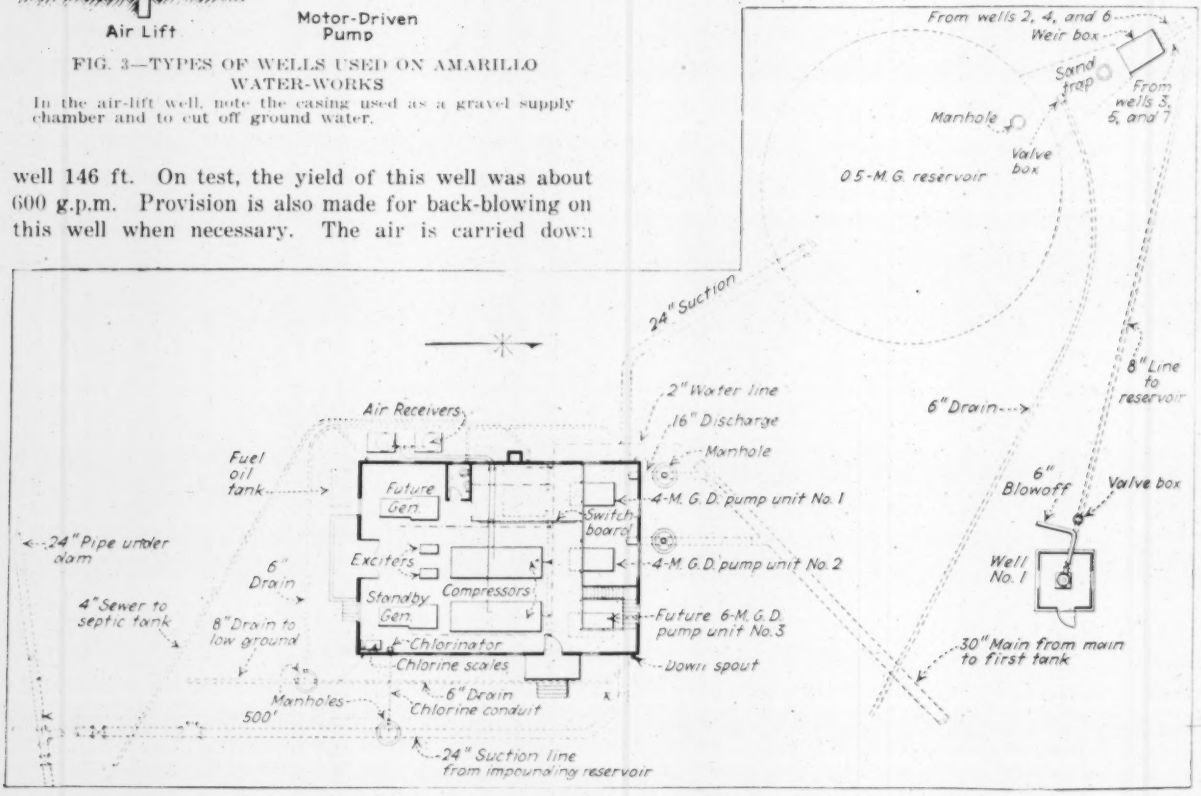


FIG. 4—PUMP STATION AND RESERVOIR LAYOUT AT SITE OF WELLS

New Pennsylvania Law Restores Licensing of Engineers

Wording of Law Declared to Be Unconstitutional Is Modified to Suit Findings of the State Supreme Court

A NEW license law for professional engineers and land surveyors for the state of Pennsylvania was signed by the Governor on May 6, 1927. It was passed to replace the license law declared unconstitutional by the Supreme Court of the Commonwealth in an opinion made public Jan. 24 of this year. The old law was attacked on the grounds that it legislated on more than one subject, namely, engineers and land surveyors, also that by its exemptions it interfered with "the equality of opportunity." The new law is so worded as to indicate that surveying is but one branch of the practice of professional engineering, and its exemptions have been altered to give engineers who are citizens of Pennsylvania equal opportunity with those from outside the state. Richard L. Humphrey, president of the State Board for Registration of Professional Engineers and of Land Surveyors, states that the essential features of the new law are:

(1) It regulates the practice of the profession of engineering in all of its branches including surveying, in order to safeguard life, health and property.

(2) The definition of the term "professional engineer" means a person who through technical knowledge gained by education or by experience in one or more branches of engineering including surveying, etc., is competent to be placed in responsible charge of engineering work. The term "surveyor" means a person engaged in that branch of engineering known as surveying. The extent of the work that may be made by a surveyor is the preparation of plans and specifications for minor engineering work not involving safety to life, thus making it possible to register borough engineers, county engineers and men doing similar work as surveyors, allowing them to continue in the work without the necessity of granting a certificate of registration as professional engineer, as provided in the old act.

(3) The age limit has been reduced from 25 to 21 years.

(4) The only exemptions provided in the new act are officers and employees of the government of the United States while engaged within Pennsylvania in the practice of engineering in any of its branches including surveying for said government; and a person having no established place of business in the commonwealth, who practices the profession of engineering in any of its branches including surveying exclusively as a regular employee of a public service company, as defined in the Public Service Law, by rendering to such company engineering service in connection with its facilities which are subject to regulation, supervision, and control in order to safeguard life, health and property, by the Public Service Commission of the Commonwealth of Pennsylvania, so long as such person is thus actually and exclusively employed, and no longer; provided, that such company shall have at least one engineer registered under the provisions of this act in responsible charge of such company's engineering work in Pennsylvania.

(5) Each year of teaching or of the study of engineering in a school or college satisfactory to the board shall be equivalent to one year of active practice, and not one-half year as provided in the previous bill, with a total not to exceed four years.

(6) Registrants under the former act may, upon the payment of the renewal fee, exchange their registration card for 1927 or 1926 for a 1927 registration card issued under the new act.

(7) Under the previous act certificates were granted as professional engineer, professional engineer and land surveyor, and land surveyor; under the new act only professional engineer, and surveyor are granted.

(8) Each registrant must secure a seal which shall be used on plans, specifications, plates and reports issued by him or her.

(9) The act provides for the right of appeal from decisions of the board to the court of common pleas of Dauphin County.

(10) A fine of $500, or imprisonment for three months, or both, is imposed for the violation of any provisions of the act.

The act, in other particulars, is similar to the old act except as to minor changes.

In the exemption clause of the former law, which was the one criticised by the Pennsylvania Supreme Court, engineers in the employ of the federal government or of corporations engaged in interstate commerce were exempted, and their practice was not restricted to engineering work for the government or for the corporations employing them. In regard to railroad employees the court said: "What reasonable grounds can there be for permitting officers and employees of corporations engaged in interstate commerce to practice the profession of engineering in Pennsylvania without registration, while requiring all officers and engineers of corporations not engaged in interstate commerce to be registered? It will be observed that this does not say that these officers and engineers are exempt merely while engaged in interstate commerce work; on the contrary, they are wholly exempt from registration, and they freely practice the profession of engineering in our state." The same comment was made concerning employees of the federal government. The new law exempts government engineers only when employed on government work and exempts the employees of public service companies instead of corporations engaged in interstate commerce, as that term was not sufficiently inclusive, only when employed in connection with public service company facilities and when the company has a registered engineer in charge of its work as noted above.

The relation of engineers and architects is specified as follows: "Nothing in this act shall be construed to prevent any person who is qualified to use the title registered architect from doing such engineering work as is incidental to his architectural work or to prevent any person who is qualified to use the title registered professional engineer from doing such architectural work as is incidental to his engineering work."

The section of the old law which provided that after a certain date it shall be unlawful for the state or any of its subdivisions to engage in the construction of any public work involving engineering unless the plans were approved by a registered professional engineer has been stricken out of the law as the Supreme Court indicated that this constituted legislation upon a different subject, which is unlawful in Pennsylvania.

State Highway Developments of 1926 Awarded Blue Ribbon of Distinction by State Highway Engineers

SIXTH ARTICLE

Developing Traffic-Bound Roads at Low Cost

By Harry J. Kirk
State Highway Engineer, Columbus, Ohio

OHIO RIVER ROAD BEFORE IMPROVEMENT

UNTIL about four years ago state highway activities were confined almost exclusively to the building of paved roads. The result was that on Jan. 1, 1923, after fifteen years on the job of building a state system of 11,000 miles, only 4,050 miles were paved and under state maintenance and the state routes, with very few exceptions, were frequently marked by short unimproved gaps which made through travel very difficult. This was particularly true in the poorer communities which had not been able financially to co-operate in building state roads. Such parts of the state were practically mud-bound during the spring months.

If roads were to continue to cost $30,000 per mile and more it was only a problem in elementary arithmetic, knowing the amount of funds available for road purposes, to figure that it would be many years in the future before agriculture, industries, churches and centralized schools in these communities could expect relief. There was a popular demand for an immediate change in policy. The only solution was a low-cost road that would be passable and smooth the year round.

ALTHOUGH during 1926, as has been true for several years past, about 400 miles of pavements were built, including many notable bridge structures, under the State Highway Department, the improvement of an additional 1,700 miles of old roads, impassable for much of the year, by the use of traffic-bound surfacing and at a cost averaging not over $3,000 per mile for the first year, is by far the most outstanding highway accomplishment in Ohio for 1926. No work that has ever been done since the State Highway Department was organized has met with such popular approval.—G. F. Schlesinger, *Director of Public Works.*

An analysis of the problem as it affected the state system as a whole showed the roads divided into four classes: (1) Those portions already paved, (2) those portions which demanded immediate paving and for which funds were available, (3) those portions which, from an economic point of view, should be paved but for which only limited funds were available, and (4) those portions upon which expensive construction could not be justified because of light traffic. Evidently the first two classes were cared for but a problem was present in classes 3 and 4, and study was concentrated on them.

The Answer—The Low-Cost Road—The low-cost road was the only answer to the problem presented by these last two classes. Nearly all the work for the first year was done at a cost of not over $3,000 per mile, not including large bridges and culverts. Expenditures greater than this had to be made where heavy grading was necessary or where surfacing materials were costly. Some of the grading and structure work was done by contract and a traffic-bound surface generally of local material was added later. By far the greater part of the grading and small structure operations were by the day-labor method. This obviated the need for, and the delay in making, detailed plans and surveys. The best line and grade commensurate with the funds available was obtained.

As noted above, 1,700 miles were thus handled in 1926. This was made possible by an organization of men and equipment developed over two or three years previous which had been gradually able to increase the miles improved each season. The job required a large amount of equipment, particularly graders and tractors. Some of it was war surplus, but a large part of it was purchased by the State Highway Department through competitive bids. The biggest problem was to train men to do the work well with the limited funds available. This could not be accomplished in one season.

Local Materials Used Extensively—Work of this kind was done in 81 of the 88 counties in the state, and the methods employed had to be adapted to get results in the flat country of the north and west, as well as in the semi-mountainous districts of southeastern Ohio. Fortunately the state is blessed with a variety of local road building materials—gravels, limestones and sandstones—and these were used wherever possible. In the eastern and northeastern part of the state where local materials are scarce, slag from the steel plants in this section was used quite extensively. Materials were shipped from commercial plants, where obtainable, over the railroads. Where railroad facilities were not available local state-owned plants were operated.

Alignment, Right-of-Way and Grading—Very little detail surveying of projects such as is necessary where

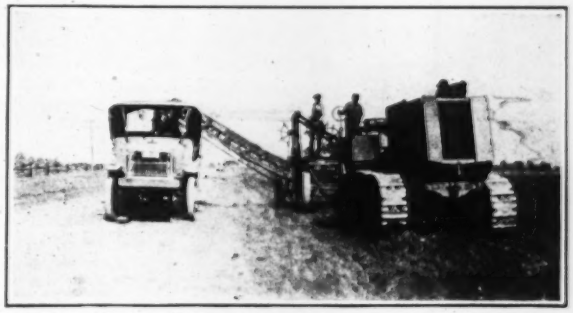
OHIO RIVER ROAD AFTER IMPROVEMENT

elaborate plans must be prepared was done. Changes in alignment were not very material except in cases in hilly parts of the state where grades, curves or drainage structures made them desirable and yet possible at small cost. Having determined the alignment the next step was to get right-of-way where needed. In most all cases a minimum of 60 ft. was obtained. All telephone poles, fences, etc., were then ordered moved to the right-of-way lines. Grading was done usually by 10-ton crawler type tractors and 12-ft. graders working in pairs. End hauling was done with slip and Maney scapers, elevating graders and trucks or steam or gas shovels with dump wagons or trucks. Standard width roadway was obtained wherever possible. Culverts were lengthened and rebuilt. In some cases where funds

GRADING WITH 10-TON TRACTOR AND 12-FT. GRADER

were low and timber available wooden culverts and bridges, the latter designed to carry the heaviest loads that might come upon them, were built. It is emphasized here that at every step in the work advantage was taken of every short-cut to keep down cost and give a smooth, safe road open to travel in all seasons of the year.

Surfacing Materials—The road grade was finally shaped to a very flat crown and made ready for the surfacing materials. These consisted of either gravel, limestone or slag. Sometimes a base of sandstone was used. Usually about 1,000 tons of surfacing material per mile was spread on the prepared subgrade for the first application. For limestone and gravel the size found best was that passing a 1-in. opening and retained on a No. 10 sieve. For slag the upper size limit was cut to ¾ in. Gravel gave better results which consisted of about 40 per cent crushed material. For first or base course applications soft materials were used in some cases where the cost was lower than for those of better quality. For the surface or maintenance course it was found desirable to use a hard material free from clay or dust, such that it would not bind up under traffic and go into pot holes. In this type of surface, as is generally the practice with all gravel roads, a thin layer of loose material should be kept on the surface at all times. Soft materials, gravel containing clay, etc., bind up so completely that the surface cannot be kept smooth by dragging because soon there is no loose material to drag over the surface to fill up developing holes.



ELEVATING GRADER LOADING EARTH FOR END HAUL

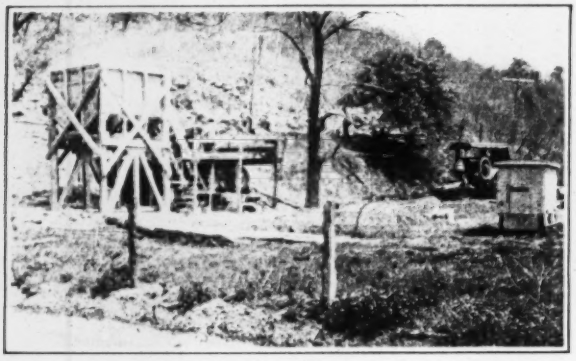
The materials used were obtained from commercial plants wherever possible. Much of the hauling of this material was done by hauling contractors. In some localities local quarries had to be opened up. Rock drills and air compressors, also used in places on heavy grading, were employed in blasting operations. Jaw and gyratory crushers were both successfully operated in crushing limestone and gravel. These had a capacity of about 150 cu. yd. per day. A type of one unit gravel crushing and screening plant was found very successful in putting out about 300 cu.yd. per day. Dragline outfits and rubber belts were found very economical in handling gravels.

Surface Construction and Maintenance—Materials as

WOODEN BRIDGE WHERE FUNDS WERE SMALL

above described were spread out of dump trucks and bladed to the side of the road, leaving only about a 1-in. layer on the surface. Traffic was allowed over the road at all times from the start of the first grading operation. Under traffic the loose material gradually packed into the subgrade, the surface being kept smooth all the time by dragging or blading. Under this system the weak

places developed and more material was dragged in from the windrows or storage piles lined along the sides to fill up soft spots and gradually build up a surface packed from the bottom up and designed to carry loads with the use of the smallest possible quantity of road metal. A smooth surface was maintained by frequent



LOCAL QUARRY, CRUSHER AND BIN

dragging all the while, keeping a thin layer of loose material spread over the surface. After a while all the material originally spread to the sides was compacted and a new layer was applied.

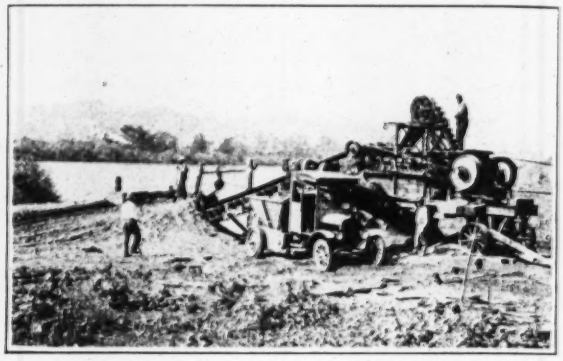
Old Road Metal Used for Base—Wherever possible the existing road metal was used for base. This was never scarified unless necessary to remove very excessive crown. The use of light crowns no more than 4 in. in 18- or 20-ft. width was found best, just enough to drain the water off successfully. The folly of old methods of dumping gravel in the center of the road and then abandoning it to the maledictions of the passing motorist with an occasional blading to procure a hog back crown was brought out forcibly.

Maintenance of Traffic-Bound Roads—A combination

OLD METHOD OF PLACING GRAVEL

of equipment has been found necessary to keep good surfaces. One-man patrol power graders with both straight and spring blades followed by an occasional planing with large sled drags gives excellent results. The length of road cared for by one man depended upon the amount and kind of traffic, weather conditions and the character of the subgrade and kind of road metal.

In addition to over 6,000 miles of pavements, Ohio is maintaining on the state system about 3,200 miles of road developed by the traffic-bound methods described above. About 1,200 or 1,300 more miles will be improved in this manner in 1927. These roads are located for the most part in rural communities, although unpaved gaps on heavily traveled roads have been thus quickly put in shape successfully to give service until funds are available for paving.



CRUSHING AND SCREENING PLANT WITH DRAGLINE

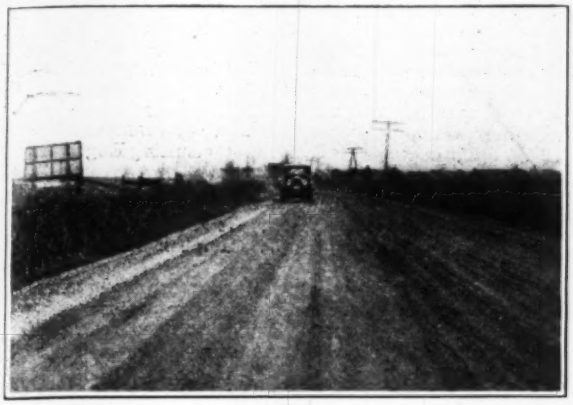
Bituminous Treatments to Allay Dust—These surfaces will carry economically 500 to 600 vehicles daily. With heavier traffic or through villages where dust is very objectionable other steps have been taken. Calcium chloride has been used successfully in some places. Surfaces that have been developed for at least one season have been given bituminous surface treatments with excellent results. One method that gives promise of widespread success and comparatively low maintenance cost consists of using a prime coat of light tar followed by an application of ¼ gal. heavy asphaltic oil applied at about 250 deg. F. and covered with ¼ to 1 in. of hard stone chips at the rate of 100 lb. to the gallon and rolled in. These bituminous-treated gravel surfaces can be made as smooth for travel as any hard-surfaced pave-

BLADE SLED DRAG

ment ever built, and much smoother than surfaces built in times past.

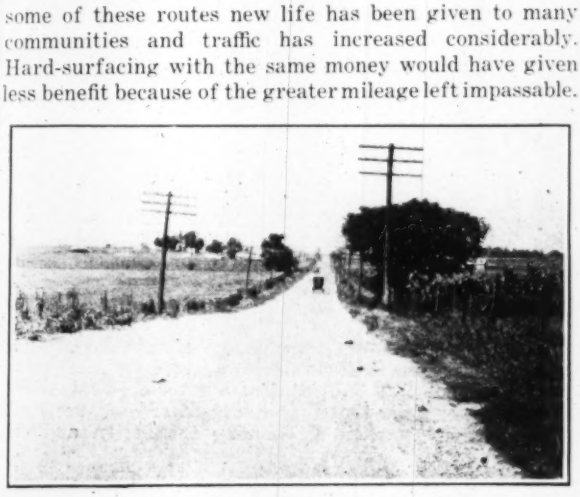
Popular Approval of Work Done—Roads of the type herein described have filled a great need and have met with great popular approval. They have proven to be the solution of the problem where roads must be had and funds are not available for pavements. The work done along this line on state roads in Ohio, co-operatively by the state and counties, has proved a great object lesson to authorities responsible for our back

roads. It has shown those who have very limited funds what can be done with a little money intelligently expended. Taxpayers in the communities where those roads have been built almost over night have been agreeably surprised and have thus become more friendly to expenditures for road purposes. Since opening up



CALCIUM CHLORIDE TREATED ROAD

some of these routes new life has been given to many communities and traffic has increased considerably. Hard-surfacing with the same money would have given less benefit because of the greater mileage left impassable.



BITUMINOUS SURFACE TREATED GRAVEL ROAD

With plenty of funds it is easy for an engineer to design and build a pavement of excellent quality; but to take the same funds and bring relief to a large area that would have to wait many years for scientifically-designed and well-built pavements, in the meantime paying a mud tax much greater than the cost of pavements, is to our mind a much greater accomplishment.

Gage Standardized in Egypt

With the change from narrow to standard gage on the southern line of the Egyptian Government Railways, from Luxor to Shellal, 135 miles, the entire system of 2,050 miles is now standard gage and the time from Cairo to Shellal, 550 miles, has been reduced by four hours. The Luxor-Shellal line was built originally as a military railway of 3½-ft. gage and was 160 miles long. The new work includes strengthening bridges and reballasting tracks. All this work was done by railway forces in about ten months at a cost of about $1,300,000 and without interrupting the traffic on the narrow-gage line.

Sewage Screening Plant Operating Costs, Long Beach, Calif.

SINCE 1916 sewage from the city of Long Beach, Calif., has passed through a screening plant whence the effluent discharges through an ocean outfall. The screenings have been buried in the sand or burned in the incinerator which is part of the plant. In 1924 worn out screens were replaced with two 10-m.g.d. Dorrco drum screens, and while this reconstruction was under way the incinerator was entirely rebuilt to take advantage of previous experience at this plant and operating experience with similar plants in England. A description of the reconstructed plant appeared in *Engineering News-Record*, July 24, 1924, p. 136. Cost data and other operating information for the present installation follow.

OPERATING DATA, SEWAGE SCREENING PLANT AT LONG BEACH, CALIF.

	1925 Calendar Year Jan. 1 to Dec. 31	Fiscal Year July 1, 1925, to June 30, 1926
Total sewage screened, m.g.	2,689	2,634
Screenings burned, tons	2,494	2,507
Screenings burned, cu.ft.	80,000	80,220
Ash removed, tons	30	29
Power used, kw.-hr.	93,560	71,180
Lighting plant, kw.-hr.	7,798	5,549
Consumption of natural gas fuel, cu.ft.	9,012,400	8,493,200
Total operation and maintenance cost per m.g. of sewage screened	$6.65	$6.60
Cost for labor, materials, power, light and water, average per M. cu.-ft. of sewage	.20	.20
Cost for incineration per ton of wet screenings:		
Fuel*	.72	.69
Labor	.66	.60
Total	$1.38	$1.29

* Natural gas, heat content 1,150 b.t.u. per cu.ft.

As the plant is now arranged the screenings are discharged directly into the inverted cone-shaped hoppers of pneumatic ejectors. These ejectors function periodically, delivering the screenings to a steel hopper mounted on scales directly over the incinerator. The hopper is large enough to act as a storage bin when desired. After being weighed, the screenings are discharged by gravity from the hopper onto the grate of the incinerator. Ashes from the incinerator are used for filling in around the plant site. Incinerator operation is controlled by recording pyrometers and throughout the plant as a whole extensive use has been made of control and recording apparatus.

Detailed records of operation during the last fiscal and calendar years are given in the accompanying table. During this period 8,760 furnace temperature readings were taken of which the highest was 1,690 deg. F., the lowest, 1,561 deg. F. The usual stack temperature is 860 deg. F. The furnace made one continuous run, 24 hr. daily, from Dec. 20, 1924, to Aug. 4, 1925, after which it was shut down 5 days for overhauling. Only minor renewals and replacements were required in the furnace at this time. During the 5 days the screenings were buried in the sand near the plant.

The operation of the Long Beach screening plant is under the general direction of A. H. Adams, assistant city engineer. Robert Appleton was in charge of the plant for several years and is given credit, in large measure, for the excellent results obtained.

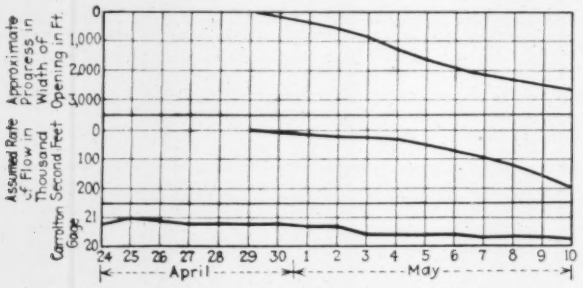
Letters to the Editor

A Forum for Discussion of Views of Engineers and Contractors

Spillway Gives Relief at New Orleans

Sir—Referring to the article on p. 789 of the current issue of *Engineering News-Record:* It is noted that a statement is made that the Caernarvon crevasse (or more properly the "Caernarvon Relief Outlet") "caused no change in the river gage height at New Orleans, though it may have restrained the flood from rising at that point."

I am handing to you herewith a graph compiled from the gage heights as shown in the above article together with approximate and assumed progress in the construction of the outlet and the assumed rate of flow in thousands second-feet through the outlet. A comparison of these graphs would indicate that there was a direct relation between



EFFECT OF CAERNARVON RELIEF OUTLET

the opening of the outlet and the lowering of the river at New Orleans, the amount probably being 0.5 ft. of actual lowering besides the undoubted effect of preventing a rise as suggested. While this 0.5 ft. would not mean much in upper regions of the river where the variations are great, it is a substantial gain at a point so near the mouth. Attention also might be given to the fact that the Carrollton gage, to which all recent records are referred, is at the upper city limits and the bulk of the city frontage has secured a substantially greater amount of relief.

Please note that the graph showing the assumed rate of flow has been drawn to indicate only a slight increase during the first five or six days. It is probable that the graph is considerably in error, though it is quite certain that there has been a decided tendency for the rate of flow per given unit of length of opening to increase during the later period. This is due to the fact that a wide batture existed between the levee and the river, and this batture was covered by a heavy growth of willows. These willows have gradually disappeared, indicating a substantial gain in depth of channel.

ARTHUR M. SHAW.
Consulting Engineer.

New Orleans, La.,
May 17, 1927.

Railroad Guard Rails a Source of Trouble

Sir—In the editorial on p. 473 of your issue of March 24, 1927, entitled "Can the Switch and Frog be Improved?" you have made a very good case against the present day practice, but in my opinion you have overlooked the strongest argument against the present frog with rigid guard rails, namely the effect on rolling stock.

Very few of us who ever make use of the railways can say that they have never noticed any jar even when riding in a sleeping car weighing from 50 to 70 tons. These jars are usually caused while the car is passing over a frog or a combination of frogs as at a diamond crossing. If the shock to a 60-ton car with six-wheel trucks can be felt by a passenger we can imagine what happens to the poor freight car with four-wheel trucks less carefully constructed.

There are four major defects in rolling stock equipment that can largely be laid at the door of the guard rail, namely, loose wheels, sprung axles, broken flanges, and sprung truck frames; the result of the latter defect is the wearing of one sharp flange on a pair of wheels. I believe it will be conceded that from 75 to 90 per cent of the wheels removed on account of worn flanges, in freight car service, have only one wheel of the pair with sharp flanges. I realize that there are other causes that bring about this result such as poor mating of wheels and a difference in the temper or hardness of the wheels, but whatever the cause the greatest expense is not the cost of the wheel, but rather the cost of the coal it took to pull the wheel while it was grinding itself and the rail away.

The same remark may be made about the other defects. It is not the cost of renewal that counts but the cost of the resulting wrecks caused by these defects.

Trusting that you will keep up the good work,

J. G. SULLIVAN,
Consulting Engineer.

Winnipeg, Man.,
May 5, 1927.

Coast Protection—Suiting Type to Conditions

Sir—I have read in *Engineering News-Record*, March 31, p. 540, a contribution by H. V. Campbell in which Mr. Campbell intimates:

(a) That the step-face seawall of reinforced concrete offers the one solution for coast erosion problems;

(b) That rock or timber or combination groins or jetties are mere temporary structures which represent a waste of money.

Mr. Campbell in advocating his reinforced-concrete seawall describes it as "an absolute protective device" and "permanent, impregnable to ocean forces." This is strong praise and subject to examination.

If there is one outstanding difficulty (other than financial considerations) in coast-protection work and one chief source of discouragement and failure, it is that engineers and laymen, particularly laymen, are prone to advocate one type of protection as a cure-all. On the other hand, the engineer with experience in this field learns that he must plan his structures and select the materials to meet existing conditions and difficulties. Obviously, it is not sound engineering to recommend the expenditure of large sums of money for the construction of rock jetties or rock or concrete seawalls where conditions indicate inexpensive groins and timber bulkheads. On the contrary, in situations where rapid tidal currents impinge on a shore, aggravating the action of heavy waves, substantial structures must be provided.

Rock, timber, steel and concrete are all useful materials in coast works, but each should be accorded its place; and, as in other departments of engineering, the economic availability of materials, the climate, degree of exposure, etc., have much influence in determining the design and the selection of materials.

Reinforced concrete has its place, and a large place, in modern construction, but it is not economically adaptable to every possible situation on the ocean front. It has certain defects which must be recognized: (a) it is a monolith, hence cannot accommodate itself to scour, or settlement in any serious degree; and (b) it requires the erection and maintenance for considerable time of elaborate timber or steel forms.

Some scour in sections of a beach must be expected and provided for as necessity requires, and there are areas where the exposure to the sea is so severe that the construction of forms is economically out of the question.

The northern coast of New Jersey adjoins the great orifice of the vast estuaries which compose New York Harbor. Deep water is close inshore, the wave attack is heavy and tidal currents are relatively rapid. The barrier beach which extends from the North Long Branch headland to Sandy Hook is low and shallow, and was breached many times prior to the construction of the present breakwaters and seawalls. Nature intended that Sandy Hook should be an island or should possibly be connected to the mainland direct and that the inlet opening from Shrewsbury and Navesink Rivers should oscillate up and down with the littoral drift; and it has manifested this intention too frequently.

Erosion progressed along this strip of beach until certain properties were seriously damaged and the very existence of the borough of Sea Bright was threatened. When private owners had become discouraged and the very existence of the aforesaid municipality was in question, the public authorities lent their aid.

In these operations rock breakwaters and seawalls were employed. The War Department engineers who have served in many parts of the world, the railroad engineers who are required to preserve the Central Railroad of New Jersey railroad line, and the engineers of the state of New Jersey, which perhaps has carried out more coast protection work than all other states combined—all these men agree that in this section rock seawalls and breakwaters offered and still offer the best solution. It is fair to say that no breaches have occurred wherever this form of protection has been provided.

Mr. Campbell's claims for reinforced-concrete sheetpiling will probably be questioned in some quarters. If the driving is hard, there is serious tendency for the concrete to spall, facilitating exposure of the reinforcing material to the sea water. This is always a bad condition. Without an adequate cutoff any monolithic seawall is in a very hazardous condition if it is not well above the line of high water. There are situations where it is impossible to drive sheetpiling owing to the existence of submerged rocks, concrete blocks, etc.

Lest the writer be accused of undue provincialism and prejudice he can say that within the last few weeks he has submitted plans for a large program for coast protection in a southern city, which involves the consideration of a concrete seawall to rest on concrete piles and steel (not reinforced) sheet-piles, to be connected to a system of wooden and steel groins. Furthermore, he has within the last six months been called upon to review the plans for four different types of reinforced-concrete seawalls, every one of which violated some of the engineering principles that must be recognized in planning coast-protection works. Sound engineering principles are just as much required in coast-protection works as in any other field of engineering, and the application of these principles requires taking into account the peculiar hazards of this department of construction. Many types of design which would serve very well on an inland lake or sheltered bay will fail where the seas are heavy and where the wall is certain to be struck by wreckage.

VICTOR GELINEAU,
Director and Chief Engineer of the New Jersey Board of Commerce and Navigation.

Jersey City, N. J.,
April 9, 1927.

Sir—It seems to me that Mr. Campbell's conclusions about the "stepped" seawall have been made without the necessary careful consideration of the entire problem. As a matter of fact the stepped seawall is not only unnecessarily expensive but is far from being a satisfactory solution of the problem of shore protection. The fact that many miles of these walls have been built in the last few years does not prove anything in their favor.

The stepped type of seawall does "break up" the waves to a certain extent but so does any other seawall with at least the same degree of efficiency depending upon the location and height of the wall with relation to normal tidal action.

Erosion of the coast line can be checked only by properly built groins, and these are just as effective or worthless, as the case may be, in front of either type of seawall or bulkhead. The reason is that the erosion or accretion of the shore depends upon factors that can only in rare cases be controlled by bulkheading. Even in such cases the location of the bulkhead is of prime importance, the *form* itself being of secondary value.

The principal disadvantages of the stepped seawall are:

1. An unnecessarily large area of unprotected concrete is exposed to seawater action.

2. The so-called "steps" form a depository for seaweed and other growths. These decay and produce insanitary conditions. The cleaning of the "steps" involves an expense eliminated with vertical bulkhead walls.

3. The "steps" introduce compound stresses in the wall absent in any other type. These can not be counteracted by such methods of design and construction as have, so far, been adopted. Although an excessive amount of steel and concrete has been employed in some of such walls it has been impossible to eliminate large cracks.

4. The method of construction is faulty because the toe of the wall rests on a short concrete sheetpiling which has practically no supporting value, especially because it is placed by jetting. The belief that the wall is safe against undercutting to the depth of the sheetpiling is erroneous for the reason that the pressure from the backfill pushes the bottom of the wall outwards long before the piling has been exposed to its entire length.

There are now about 40 miles of such seawalls in use and construction along the Gulf Coast in Mississippi and Louisiana costing about $22 per lineal foot of wall. The same walls could have been built at a saving of over $10 per lineal foot or at a total saving of over $2,000,000.

Various types of seawalls are possible. However, each individual shore-line section requires most careful study and analysis of local conditions and requirements.

CARL WEBER,
President, Shore-line Builders, Inc.

Jacksonville, Fla.,
April 6, 1927.

Joint Meeting to Build Second and Larger Trunk Sewer

Sir—It has taken about four years of concerted effort to bring together eleven inland municipalities in Essex and Union Counties, New Jersey, in a joint enterprise which will provide adequate supplementary sewerage facilities and proper sewage disposal into tidewater. Treated as a construction job in the metropolitan district in these days of vast enterprises involving many millions of dollars, this project has no strikingly unusual features; but when one considers the difficulties of getting eleven municipalities to join in a common enterprise, conducted so that each unit maintains its identity and power instead of giving over the control of the work to a district commission without the right of individual expression or choosing the alternative of being annexed to or absorbed by a greater municipality for the purpose of accomplishing the object sought, then this enterprise has much of general interest. This has been done for the second trunk sewer, as it was for the first, through the agency of a "joint meeting."

This project is the outgrowth of a joint sewer undertaking built under the supervision of the writer twenty-five years ago to serve municipalities which have grown beyond all expectations, partly as the result of the building of this sewer and its tributaries. It was built with a maximum daily capacity of 21 m.g. but the new plans provide for 100 m.g. The existing sewer became so overcharged that we have been maintaining an intolerable nuisance due to the sewage overflowing at manholes and entering directly into streams used for two water supplies. These overflows occur within a few miles of the water-works intakes, with an aggregate volume as great as 10 or 15 m.g.d. of dilute sewage.

Notwithstanding these conditions, the municipalities have been obliged to delay the construction of the work because the State Department of Health would not permit the joint body to proceed forthwith with the necessary relief afforded by the supplementary sewer, unless a sewage disposal plant was also constructed. The effluent is, and will be, discharged at tidewater.

Although ready and willing to construct this supplementary sewer and disposal works, the State Department of Health would not allow us to proceed unless the municipalities within whose limits the disposal plant was located and over which the department named has no control, would consent to its location within their boundaries. The tidewater municipalities have refused to permit the construction of this disposal works.

Realizing the menace of polluted water supplies and cellars flooded with sewage, in order to secure the approval of the State Department of Health we have been obliged to accept an impractical site for a disposal plant five miles from the proper point of discharge. The only reason for the selection of this site is that it is within the limits of a municipality that will grant the right to construct it.

The contract entered into between these various municipalities comprising the joint meeting provides for a most equitable method of distribution of the cost; gives the joint meeting control over the laterals and house connections in the contributing municipalities for the purpose of reducing leakage; and provides an equitable plan for penalizing those municipalities which exceed or tend to exceed their allotment.

ALEXANDER POTTER,
Consulting Engineer.

New York City,
April 18, 1927.

More About Pit-Run Aggregate

Sir—In *Engineering News-Record*, March 24, 1927, p. 500, there is contained a criticism by Stanton Walker relative to my paper "Proportioning Pit-Run Aggregate in Concrete," published March 10, 1927, p. 399.

The limitations in the use of pit-run concrete are well known to engineers and foremen using concrete. They are clearly stated in Crum's original paper. Mr. Walker in arraigning the use of pit-run aggregates makes a special plea for screened and graded aggregates. It will be recalled that when Mr. Walker's interests were slightly divergent from those of the present time he insisted "that the quantity of mixing water expressed as a ratio to the volume of cements dictates the strength of the resulting concrete, regardless of the mix, consistency, and grading of aggregate, so long as the concrete in plastic" (*Proc.* A.S.T.M., Vol. XIX, Pt. II, p. 546).

The statements in Mr. Walker's letter that the writer ignores the water-cement ratio and rules of grading are erroneous. Feret's researches upon which Crum's method and the writer's formula are based take explicit cognizance of a water-cement ratio in the form $c/(e + v)$, where c = cement, e = water-voids and v = air-voids (Johnson's Materials, 5th ed., p. 455). This ratio includes that recommended by Mr. Walker as a special case. Just as Edwards' method of proportioning implicitly takes account of the grading, so does Crum's, not only in making the cement proportional to the sand, but by weighing the aggregate as well; in fact the formula of the writer should apply equally well to either graded or pit-run aggregates, with possibly a slight variation of the parameters p and c which would need a readjustment.

A plat of the data in one of the modern super-researches on concrete—on account of its promiscuous character—has been compared by one well-known authority, in a communication to the writer, to a charge of bird-shot fired at a sheet of cross-section paper. The writer believes that there is scarcely a branch of scientific research in which so little attention is devoted to correct experimental techniques and the scientific study of the range of variation of data as in this particular field. One may refer as an example to Mr. Walker's own paper on the "Modulus of Elasticity of Concrete" (referred to above) where he is found to average at times at high as eighty individual test results to give a single datum on his plats, leaving the law of variation for the assemblage defined by this datum to the credulity of his readers.

In Crum's method of proportioning the range of variation in stress is not left to the credulity of the engineer but is confined to definite amounts, (±) 10, 15 and 20 per cent from the means for the classes of concretes I, II and III respectively. In their purely analytical aspects Crum's charts are plats of the mixes required to give definite strengths of concrete in compression at 28 days as found by tests in terms of Feret's arguments c = cement = a function of the sand percentage, and w = unit weight of aggregate = a function of density = 1 — voids. The formula proposed by the writer is a concise analytical statement of Crum's theory and is, of course, subject to the limitations of the latter.

J. H. GRIFFITH,
Professor of Experimental Engineering,
Iowa State College.

Ames, Iowa,
April 18, 1927.

Designing Equivalent Concrete Mixtures

Sir—I have read with considerable interest Professor Griffith's article on the proportioning of pit-run aggregate for the manufacture of concrete based on Crum's "sand method," as published in *Engineering News-Record*, March 10, 1927, p. 399, together with various comments appearing in following issues.

Without going into the merits of Crum's "sand method" of proportioning concrete aggregates, but rather assuming that there are sufficient experimental data to support his conclusions, it seems to me that it is not necessary to resort to approximate formulas. No doubt Professor Griffith's formulas are within the limits of values required, but it appears that absolute formulas may be more easily derived. That is, formulas may be developed from the same data from which the diagrams for the volumetric proportions were devised and which will give identical results.

In Bulletin 60 of Iowa Engineering Experiment Station, published May, 1921, Mr. Crum shows that in order to maintain equivalent concrete for each one per cent increase by weight in sand content a reduction of 0.05 parts by weight should be made in the total amount of aggregate.

For Class 1 concrete containing 100 per cent of sand, Mr. Crum uses a proportion of total aggregate to cement, by weight, of 2.65 to 1. Reducing the percentage of sand by 100, the increase of total aggregate becomes 100 x .05 or 5.0. This added to 2.65 equals 7.65, the proportion of total aggregate to cement by weight for an aggregate containing no sand being 7.65 to 1. This may be expressed in formula form as follows:

1 lb. of cement to $(7.65 - 0.05\ S)$ lb. of aggregate, or one bag of cement (94 lb.) to $(720 - 4.7\ S)$ lb. of aggregate where S equals the percentage of sand by weight.

Similarly derived formulas for Classes 2 and 3 are:

Class 2—One bag of cement to $(327 - 4.7\ S)$ lb. of aggregate.

Class 3—One bag of cement to $(1{,}000 - 4.7\ S)$ lb. of aggregate.

The foregoing formulas may or may not be slightly more difficult to apply mentally than those devised by Professor Griffith, but they do have the advantages of being rigorous in so far as the basic data are concerned, and their use is not restricted to combined fine and coarse aggregate, but they are equally applicable in proportioning separate fine and coarse aggregates.

During construction the field engineer is often called upon to vary the specified mix somewhat in order to expedite placing in inaccessible places. The old-fashioned way was to maintain the sand to cement ratio constant and lessen the amount of coarse aggregate used. This procedure unnecessarily penalized the contractor.

The above described method of formula derivation can be easily applied by the field engineer in designing varying mixes producing equivalent concrete. Consider the following example:

The specifications call for a mixture of 1 part cement, 2 parts sand weighing 95 lb. per cu.ft. and 4 parts screened gravel weighing 100 lb. per cu.ft. The proportion of total aggregate to cement by weight is 6.3 to 1. The percentage of sand by weight is 32. Reducing the percentage of sand by 32, the increase of total aggregate becomes $32 \times 0.05 = 1.60$. This added to 6.3 equals 7.9 the proportion of total aggregate to cement by weight for an aggregate containing no sand being 7.9 to one.

The formula becomes one bag of cement to $(740 - 4.7\ S)$ lb. aggregate, which should produce concrete equivalent to that specified in the specifications based on Crum's "sand method" of designing equivalent mixtures.

F. H. AUSTIN,
Secretary, Currie Engineering Co.

Webster City, Iowa,
April 22, 1927.

Suspension Designs in Cologne Bridge Competition

Sir—Your article of Feb. 17, p. 275, "Arch Bridge Design of 1,100-ft. Span Wins over Suspension," is unfair to the suspension designs submitted in the competition, as it mentions only the most expensive of these designs, the cost of which exceeds that of the other suspension designs by about 65 per cent. The following facts are of interest in this connection:

(1) There were submitted several suspension designs, thoroughly worked out, with spans of about 340 m. or 1,120 ft., estimated to cost about 18,000,000 M.

(2) For the 30,000,000 M. design of the Maschinenfabrik Augsburg-Nürnberg, the cost was given as "not binding," which can be explained only by the fact that the design was not sufficiently worked through and should not have been submitted at all.

(3) The design in question had four lines of cable and four stiffening trusses, the latter being plate-girders of about 20-ft. depth. The horizontal pull of the cables was resisted by these stiffening girders, not by anchorages. Those features would necessarily lead to a high weight of steel and consequently to high cost.

W. SCHACHENMEIER,
Professor of Structural Engineering.

Technische Hochschule,
München,
Apr. 16, 1927.

News of the Week

Current Events in the Civil Engineering and Contracting Fields

Mississippi River Floods Recede Slowly

River Gages Falling Except Temporary Rise Above Memphis—Bar Forms Below McCrea

Flood waters in the Mississippi River valley are receding. Reports from the Tensas basin indicate that although water still is flowing through the crevasses in the Mississippi levees the general water level in the flooded area is falling about 0.4 ft. per day. In the upper part of the Atchafalaya River basin the waters also are falling but in the lower basin the crest has not passed and additional areas of the low lands along the coast are being flooded. Iberia and Morgan City, the two principal towns of the region are reported to be flooded to a depth of a few feet.

An interesting feature of the flood situation in the Atchafalaya basin is the report that a sand bar is forming just outside the crevasse in the levee line at McCrea.

Rain in the upper Mississippi River valley has caused a rise in gages at St. Louis and Memphis which will cause an increase in the discharge through the crevasses. Gage readings for the lower-river stations are given in the accompanying table. Torrential rains are reported in the Tennessee River valley which may check the fall in main river and delay the closing of the breaks in the levee line.

GAGE HEIGHTS AT LOWER MISSISSIPPI VALLEY POINTS

	Mississippi River						Red River	
	St. Louis	Memphis	Vicksburg	Natchez	Baton Rouge	New Orleans	Shreve-port	Alex-andria
Flood stage*...	30.0	35.0	45.0	46.0	....	17.0	29.0	....
Provisional Levee grade**	....	51.5	58.0	57.5	48.1	25.2	....	....
1922	34.0	42.5	54.8	55.3	45.7	21.3	....	....
Previous high.. 1927	41.4	46.5	53.8	53.5	43.8	21.1	....	....
April 24	35.6	45.9	54.8	55.3	44.8	20.8	34.1	....
April 25	35.8	**45.9**	54.5	55.2	45.0	21.0	35.1	38.0
April 26	**36.1**	45.6	54.4	55.0	45.0	20.9	36.0	38.3
April 27	35.6	45.4	54.9	55.0	45.0	20.8	36.7	38.7
April 28	34.6	45.1	55.7	55.1	45.0	20.8	37.2	39.0
April 29	33.4	44.7	56.3	55.5	45.1	20.8	37.4	39.5
April 30	....	44.3	57.2	56.1	45.4	20.8	**37.4**	40.0
May 1	....	43.8	57.9	56.5	45.8	20.7	36.9	40.5
May 2	....	43.2	58.2	56.4	45.7	20.7	36.4	40.1
May 3	....	42.7	58.5	56.4	45.4	20.4	35.4	41.3
May 4	26.8	42.2	**58.7**	**56.5**	45.6	20.4	34.3	41.5
May 5	25.4	41.6	58.2	56.4	45.7	20.4	32.6	41.9
May 6	24.1	40.8	58.0	56.1	45.8	20.4	31.9	42.1
May 7	23.7	40.6	57.7	55.7	46.0	20.3	29.2	42.3
May 8	25.4	39.8	57.2	....	46.1	20.3	27.6	42.4
May 9	27.3	39.2	57.0	55.3	46.1	20.3	26.1	42.2
May 10	29.5	38.4	56.6	55.1	46.3	20.2	24.6	41.9
May 11	30.3	37.6	56.4	55.1	46.5	20.3	23.0	41.5
May 12	29.1	36.9	56.0	55.0	46.8	20.2	22.6	40.9
May 13	27.6	36.4	55.7	55.1	47.1	20.4	22.6	40.3
May 14	26.3	36.0	55.4	55.1	47.4	20.6	23.2	39.4
May 15	25.2	35.8	55.2	55.1	47.8	20.7	22.8	38.5
May 16	25.9	35.7	54.8	54.9	47.7	20.6	21.9	37.7
May 17	27.0	35.6	54.4	54.7	47.6	20.6	20.6	36.9
May 18	27.3	35.4	54.0	54.5	47.5	20.5	19.2	35.9
May 19	27.2	35.1	53.6	54.3	47.4	20.4	17.7	34.8
May 20	26.6	34.6	53.2	54.0	47.3	20.4	16.6	33.4
May 21	26.7	34.0	52.8	53.8	47.2	20.3	15.6	31.8
May 22	26.4	33.3	52.5	53.6	47.1	20.2	15.5	30.1
May 23	25.6	32.5	52.2	53.3	47.1	20.3	15.6	30.8
May 24	24.9	31.8	51.9	53.1	46.8	20.0	16.0	....
May 25	26.5	31.4	51.8	52.8	46.3	19.9	17.0	....
May 26	28.2	31.0	51.3	52.5	46.0	19.7	16.7	....
May 27	28.6	30.7	51.0	52.1	45.7	19.5	18.1	....
May 28	28.9	30.7	50.6	51.8	45.3	19.4	17.8	....
May 29	29.8	31.1	50.2	51.5	45.0	19.1	18.4	....
May 30	29.0	31.5	50.0	51.1	44.6	19.0	18.6	....
May 31	28.0	32.1	49.7	50.9	44.3	18.8	17.6	....

* Approximately a bank-full condition above which levees are required.

** Grade established by the Mississippi River Commission as the desired height for the levees.

Army Engineer Board to Recommend Spillways

It has been announced at Washington that the special board of U. S. Army Engineers, of which Col. W. P. Wooten is chairman, and which has been working for about a year on the question of spillways in the lower Mississippi has decided to recommend supplementary the levee system with one or more spillways. While the board will not be ready to report until September its investigations have proceeded to a point where it is convinced that a spillway relief below the Red River is justified.

Los Angeles Aqueduct Dynamited for Third Time

Some 300 ft. of the No Name siphon of the Los Angeles aqueduct, about 175 miles from the city, were blown out by dynamite on May 27, according to press reports. Guards were surprised and overpowered by armed men, said to be Owens Valley ranchers who claim that their lands have been made valueless by the diversion of Owens River and that the city ought to buy their property. This is the third incident of the kind. A second explosion on the same day is reported to have destroyed 300 ft. of pipe leading from Big Pine Reservoir to Big Pine powerhouse.

Typhoid Cases in Montreal Exceed 4,200

Cause of Outbreak Traced to Milk, and Probably Also Ice Cream and Cream, Is Report

The Montreal typhoid epidemic had resulted in some 4,100 cases and about 300 deaths for the full 12 weeks from March 3 to May 26, and there were 61 cases and 14 deaths reported on Friday May 27, according to figures supplied to *Engineering News-Record* by Dr. S. Boucher, director, Montreal Department of Health. Local press reports supplied by Dr. Boucher give 18 cases up to noon Saturday, May 28, with 11 on Sunday and 45 on Monday, thus carrying the total beyond 4,200 up to May 30. The cause of the outbreak, "was traced to milk, probably also to ice cream and cream." The "milk dealer to whom the outbreak was originally attributed" says Dr. Boucher, "has been ordered by the Provincial Board of Health to discontinue his supplies." Consumers of raw milk have not had typhoid, he states.

The accompanying table shows the course of the epidemic by weeks. It will be noted that the first crest was reached at the end of the fourth week, with 658 cases, and the second in the eleventh week, with 727 cases.

The total number of cases and deaths for the past three years, Dr. Boucher gives as follows: 1924, 150 and 51; 1925, 140 and 52; 1926, 103 and 37.

In an official report covering the epidemic up to April 30, published nearly a month later (Montreal *Star*, May 27) Dr. Boucher stated that the outbreak (with about 2,600 cases then) was the worst milk epidemic on record and expressed the belief that the worst was over. He mentions a typhoid carrier, transferred Jan. 20 from the wholesale to the retail division of one of the dealers, but gives no further information as to possible infection of the milk supply by this carrier.

From other sources than Dr. Boucher and by inference from his letter, it appears that the milk dealer to whom the outbreak was attributed soon after its beginning was one of the dealers whose supply was proscribed on May 18.

WEEKLY CASES AND DEATHS
MONTREAL TYPHOID EPIDEMIC

Week Ending	Week of Epidemic	Number of Cases	Number of Deaths
March 10	First	127	...
March 17	Second	359	...
March 24	Third	582	...
March 31	Fourth	658	35*
April 7	Fifth	491	40
April 14	Sixth	206	44
April 21	Seventh	107	42
April 28	Eighth	118	28
May 5	Ninth	102	20
May 12	Tenth	264	13
May 19	Eleventh	727	26
May 26	Twelfth	442	28
		4,103	276*

* Weekly deaths prior to fourth week not available but total from March 6 to May 26 was about 300.

California Gasoline Tax Raised from 2 to 3 Cents

A statute increasing the gasoline tax in California from 2 to 3c., passed by the recent legislature, has just been signed by Gov. Young. The measure is expected to provide an average increase of $10,000,000 per year over the 12-year period for which the tax is to be in effect and the money is to be used for construction work on primary and secondary highways.

The existing 2c. gas tax now brings in about $18,000,000 per year which is expected to increase to an average of $20,000,000 over the 12-year period. To this are added the registration and weight fees that total about $7,000,000 per year. Half this total revenue goes to the several counties in proportion to their registered motor vehicles while the other half is retained by the state for maintenance and reconstruction.

Philadelphia Baseball Grandstand Failure Due to Decay

On May 14 one bay of the right field grandstand of the Philadelphia ball park, at Broad and Huntingdon Sts., Philadelphia, partly collapsed during a game, while there was a large and active crowd on the stand. Investigation of the accident by the city's Bureau of Building Inspection showed it was due to decay of the timber main beam supporting the section.

The failed section was built in 1910, although other parts of the stand were built in 1895. The structure consists of wooden posts, girders and joists. Part of the ground below is concrete covered and part is exposed soil. The treads and risers of the stand flooring tend to produce a confined space under the stand; the resulting lack of ventilation, it is charged, accentuated the decay-producing effects of any dampness.

The longitudinal girder whose fracture caused the accident was made up to two 3x12-in. spruce timbers 12 ft. long, spiked together, carrying single 3x12-in. joists spaced 2 ft. on centers. The supports were 8½-in. square pine posts. The girder failed in horizontal shear over the post, directly adjacent to an aisle where the spectators were crowded and subjected the supports to impact as well as load. The end of the broken girder showed decay extending out from the center of the girder, but the outer faces of the timber appeared to be in good condition.

A more extensive examination of the stands made subsequently revealed decay in a number of places, and numerous other double girders made of timbers spiked close together showed partial decay, although similar girders located under a protecting roof were generally in sound condition. Decay was also found in posts at the point where they rested on their concrete pedestals close to the ground. Shoe blocks on top of the joists to level up the floor planks were found decayed from the top in many places.

The inspection was made by C. A. Flanagan, C. P. Hart, and George Warner, under the direction of Morris Brooks, chief building inspector.

Wanaque Aqueduct Changes Arouse Municipalities

Request for Hearing Made for June 2 on Why Steel Tubes Are to Replace Concrete Conduit

A request for a hearing today (June 2) on why the change has been made to twin steel tubes for the Wanaque aqueduct in place of the single concrete aqueduct, plans for which were adopted in 1924, was submitted to the North Jersey District Water Supply Commission after a meeting of residents of communities that have contracted with the commission, held in Montclair on May 26.

The meeting was called for quite another but closely related purpose, namely, to consider the formulation of a plan by means of which the municipalities comprising not only the North Jersey Water Supply District, but also the Passaic Valley Sewerage District might be informed in advance of action by either of the commissions involving the expenditure of money which would have to be provided eventually, as are all of the funds of the two commissions, by the contracting municipalities. The call for the meeting was issued by Henry A. Lardner, mayor of Montclair and vice-president of J. G. White Engineering Corporation, New York City, in accordance with a resolution adopted by the Montclair Town Commission.

Outline of Plan

In brief, the plan proposes that the twenty-odd contracting municipalities in the two districts unite in requesting the two commissions to adopt no resolution involving expenditure of money until at least two weeks after the resolution is presented and to give the contracting municipalities at least ten days' notice of the resolutions before they are finally acted upon by the commissions. It was stated that the general plan of procedure is no more than what the various contracting municipalities are required by law to do in connection with municipal expenditures. The conference decided to have the proposed plan submitted formally to the governing bodies of the contracting municipalities with a request that each municipality should send a representative to a second conference which will be held in Montclair on the evening of June 16.

In the course of the discussion of the proposal to request the Water Commission for a hearing on changes in the aqueduct plan, a representative from Paterson stated that his city had been unable to obtain copies of the engineering reports on the change in plan, noted in *Engineering News-Record*, May 5, 1927, pp. 715 and 746. Inquiry by the presiding officer led him to conclude that no other municipality except Paterson had requested the engineering report. Just before going to press *Engineering News-Record* made another unsuccessful attempt to get copies of the engineering reports, renewing by telephone its twice-made request to the president of the water commission. The latter stated that copies of the report were being made but refused to supply one at that time.

Bay Bridge Site Chosen by Board Is Adopted by San Francisco

The first choice of the engineers retained by San Francisco to select the best site for a bridge from that city to Oakland was approved by the San Francisco board of supervisors on May 23 by a vote of 17 to 1. This is the Rincon Hill-Alameda Mole location named as the most desirable by Robert Ridgway, A. N. Talbot and John D. Galloway, who were the engineers retained by the city. A review of their findings was published in *Engineering News-Record*, May 12, p. 788.

Further explanation of the report made by these engineers was given to the supervisors on May 23 by Mr. Galloway who advised that after taking final action in adopting a site, borings should be made to determine foundation conditions. The supervisors voted to send a committee of nine to Washington to lay the matter before federal authorities and make formal and specific application for permission to proceed with the project. This committee is to consist of the mayor, three supervisors, City Engineer M. M. O'Shaughnessy, the city attorney and Messrs. Ridgway, Talbot and Galloway.

Seven Concrete Segments in Place in Oakland Estuary Tube

With 300 working days yet to go, contractors building the vehicular and electric-railway tube under the estuary at Oakland, Calif., have placed 7 of the 12 concrete segments and are thus far ahead of schedule. A general description of the work appeared in *Engineering News-Record*, Oct. 28, 1926, p. 692.

Of the 7 segments that are down, four had been connected up prior to June 1 but there was access to the interior of only two because it had not been desirable to unwater until the backfill was in place. Due to encountering hard material in foundations and the inability to work more than one dredge at a time, the segments have been put down at the rate of only one per month. It is expected, however, that a rate of two per month will be attained in the near future.

Progress on the Mokelumne Water Project

Construction on the Mokelumne project which is being carried out by the East Bay Municipal Utility District to provide a water supply for cities on the east side of San Francisco Bay, has been progressing rapidly. For the most part, actual construction is being carried on as a number of independent tunnel, conduit and pipeline contracts, all under the general direction of Arthur P. Davis, chief engineer of the district. The following is the status of the project, sent by Mr. Davis May 13:

That portion of the Mokelumne aqueduct lying between San Pablo Creek and Old River, which is regarded as an emergency section, has been pushed to the partial exclusion of other work in order that an emergency water supply could be brought to the District before the reservoir in the mountains is avail-

able. This portion of the aqueduct consists of the following items, of which the Walnut Creek tunnel was completed last September and the other items have been completed to within one per cent of the total.

	Length in Miles
Lafayette tunnel	3.06
Concrete conduit	3.54
Walnut Creek tunnel	0.46
Steel pipe line (65-in. dia.)	36.60
Total	43.66

A contract has been let for pipe-line construction east of Old River, on which about four miles of pipe has been entirely completed and another mile is under construction.

Contract has been let for the Claremont tunnel, extending southwest from San Pablo Creek—virtually a continuation of the Lafayette tunnel. In the Claremont tunnel, 3.42 miles long, 27 per cent of the excavation has been completed and about 20 per cent has been lined. Work is in progress at both ends.

The Rockridge siphon, extending from Claremont tunnel to the proposed Rockridge reservoir, is 2,430 ft. in length and is about 10 per cent complete. Further right-of-way negotiations for the aqueduct are under way, a reservoir site close in has been purchased and about half the right-of-way acquired and general survey work is being carried on.

The Lancha Plana reservoir on the Mokelumne River, which requires a dam about 350 ft. in height, has been contracted with a clause providing for postponement of construction until the right-of-way is obtained. A condemnation suit for this is now being tried in Jackson, Amador County, and the start of construction awaits the outcome of this proceeding. The outlet tunnel, two miles in length, is in practically the same state, awaiting the outcome of the legal proceedings.

N. Y. West Side Plan Removes Railways from Streets

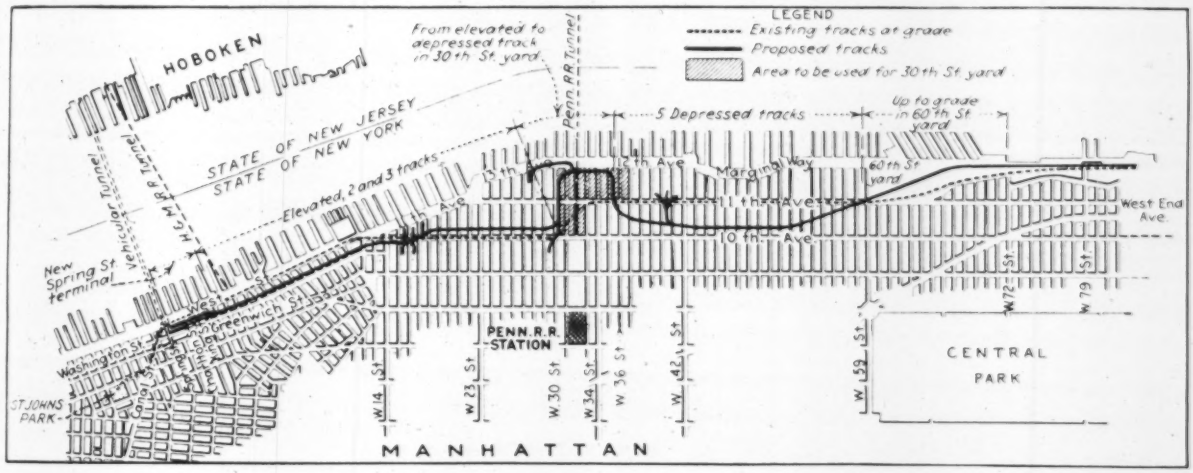
Not only complete separation of the New York Central tracks from street grades on the west side of Manhattan Island but also the removal of the tracks from their present right-of-way in the streets is proposed in the plan agreed upon between engineers representing the city, state and railroad company which was reported upon in *Engineering News-Record*, May 26, p. 880, and concerning which more details have been made available during the week.

The location of the New York Central tracks below 79th St., New York City, is shown on the accompanying plan. Above 79th St., the changes in alignment are minor. As indicated on the plan, from the Spring St. terminal north to West 16th St. the railroad will be an elevated structure in an arcade along the side of the street just inside the building line, with space for loading platforms and trucks beneath the elevated tracks. From this point north to West 30th St. the tracks will be in a private right-of-way approximately 100 ft. west of the building line on 10th Ave. The 30th St. yard will occupy much the same area as now occupied between 30th and 33rd Sts. west of 10th Ave. with additional tracks between 33rd St. and 37th St., but a considerable portion of the yard will be double deck. The main line will come in as an elevated structure at 30th St. and leave as a depressed track between 36th and 37th Sts. North of the 30th St. yard the main line will consist of five tracks depressed below street level in a private right-of-way between 10th and 11th Aves., 125 ft. west of 10th Ave. at the closest point.

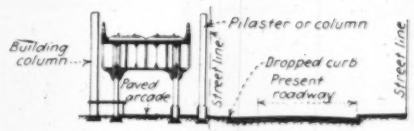
The 60th St. yard will be entirely rearranged, partly double deck, with provision made at the westerly side for the lines of columns supporting the proposed elevated West Side express highway.

North of the 60th St. yard, along Riverside Drive, the tracks follow approximately the present location and provision is made for decking over the entire right-of-way to provide for future extension of the express highway. At the Spuyten Duyvil crossing the plan calls for a double-deck, four-track lift bridge east of the present location, the express highway being on the upper deck. Beyond the river crossing there will be a fly-over connection with the main-line track to the Grand Central Terminal.

The plan calls for complete electrification.



PROPOSED CHANGES IN WEST SIDE TRACKS ON MANHATTAN ISLAND



Typical Section Through Arcade

Los Angeles Zoning Upheld by U. S. Supreme Court

The zoning ordinance of Los Angeles was upheld as constitutional by the United States Supreme Court May 16 in a decision by Associate Justice Sutherland, the court affirming the decision of the California State Courts. Hector N. Zahn applied for a permit to erect a building for business purposes in a section of Los Angeles classed in Zone B, in which only certain classes of business are permitted and in which the business to be conducted in the applicant's building did not fall. He brought suit when a permit was refused.

Later Report on Failure of Gros Ventre Dam in Wyoming

Subsequent reports on the failure of the Gros Ventre dam in Wyoming, announced in these columns last week, state that the point of failure was at the south end of the dam where impounded waters broke through about 11 a.m. on May 18 and cut out a channel 100 yd. wide and 100 ft. deep. It is estimated that the maximum discharge was 30,000 sec-ft. and that a total of about 50,000 acre-ft. went out in a few hours. After this discharge the lake level was about 25 ft. lower than before the break. When the breach in the dam had cut down to the depth mentioned, heavy material was encountered which prevented draining the lake to a lower level.

Washington Notes

SURVEYS now being made in connection with the proposed development of power at Lake Okefenokee are to be utilized by the board of Army engineers that is searching for the best route for a canal across Florida. A recent report is to the effect that the examinations under the Federal Power Commission's preliminary permit are being undertaken in a thorough manner and will include considerable information needed by the Intercoastal Canal Board.

The Okefenokee project will convert a swamp into an attractive lake and will develop 40,000 hp. One of the proposed canal routes passes through the lake which will be created.

INDICATIONS are that the Federal Power Commission will take jurisdiction over the project of the Lexington Waterpower Co. in the Saluda River twelve miles above Augusta, Ga. The proposed dam, which will contain 11,000,000 cu.yd. of fill, will create a reservoir thirty miles long covering an area of 100 sq.mi. While the Saluda River is not navigable, it is apparent that such extensive storage will affect the Congaree, of which the Saluda is a tributary. Under similar conditions the commission always has assumed jurisdiction.

EDWARD ALLEN, of Chicago, Ill., has applied to the Federal Power Commission for a preliminary permit covering a large project on the Great South Fork of the Cumberland River in Creary County, Ky., and Scott County, Tenn. The project is near Stearns, Ky.

It is proposed to construct a multiple arch dam to a height approximating 400 ft. The reservoir will extend up the river 117 miles. Some 60,000 hp. of primary power is available, but the applicant proposes to install 130,000 hp.

This application conflicts with that portion of the application of H. A. Spalding, which is on the South Fork. The Spalding project involves also the use of the power resources of the Obed and Obey rivers.

THE United States Supreme Court in a decision by Justice Sutherland May 31 upheld the set-back building ordinance of Roanoke, Va. S. M. Gorieb assailed the ordinance, which required new buildings to be set back as far from the street line as 60 per cent of the buildings in the same block. Gorieb applied for a permit for a business building and was required to set it back 34 ft. from the street line. The Supreme Court held that the ordinance as applied to him, at least, appeared reasonable inasmuch as in that particular block, 80 per cent of the buildings were more than 34 ft. back from the street line. The decision of the lower court in the case was affirmed.

Georgian Bay Canal Charter Not to Be Renewed

The bill to renew the charter of the Montreal, Ottawa and Georgian Bay Canal Co. has been killed by the Railways and Canals Committee of the Canadian House of Commons. This means that the company loses its claim to develop the important Carillon water power site on the Ottawa River, which forms part of the proposed canal route.

The bill, if carried, would have empowered the canal company to construct a ship canal from Georgian Bay to the St. Lawrence River via the Ottawa River, and would have given the company all the subsidiary power rights along the canal route. The provinces of Ontario and Quebec were opposed to the bill, and members of the House of Commons, advocating public ownership of electrical power, also made a concerted attack against it.

Grade Crossings to be Eliminated in Elmira, N. Y.

An order has been issued by the Public Service Commission of New York directing the elimination of all of the existing grade crossings on the Pennsylvania and Erie railroads in the city of Elmira, N. Y. This is the largest project so far undertaken under the grade-crossing elimination program of the state. The estimated cost of this work is over $4,000,000 and the city of Elmira has agreed to pay as its share not more than $1,500,000 for grade crossing elimination, including the crossings on the Delaware, Lackawanna & Western R.R., which are still under consideration.

Under the terms of the order the railroad companies are directed to prepare plans, specifications and estimates of cost for the work ordered, to be submitted to the commission for approval, and also to carry out the work of constructing the approaches.

Plans Under Way for Developing Northern Quebec

Premier Taschereau of Quebec has confirmed a report from London, England, that an English syndicate is planning to spend $300,000,000 in industrial development in the Lake St. John region of Quebec province. It is understood a railway is to be built around Lake St. John to extend northward to Lake Chibougamou and perhaps farther. Refineries for magnetic iron ores, smelters and paper mills will be constructed.

Sir Arthur Pease, Lord Gainsford, Richard Arthur Pease and W. H. Hustler, members of Pease Partners and Co., of Darlington, England, are reported to be interested in the scheme. The syndicate has received its charter from the Quebec Government. While no definite announcement has been made, it is understood the procedure will be first the formation of the railway company, for the construction of the proposed line around Lake St. John, then the formation of subsidiaries for each of the industries entered into, such as timber, pulpwood and mining.

Random Lines

Why We Import Steel

In the April issue of the *Bulletin* of the American Engineering Council appears a piece of information which seems to indicate that it is quite necessary for the United States to import steel — for nuts. Speaking about "Waste in Bolts," the item says:

"Economies within the reach of the industry to be had by the adoption of simplified packing is indicated by the findings of the committee of the industry pointing out that 125,000,000 tons of steel are converted annually into bolts, nuts and rivets."

* * *

Drumming Up Trade

Toll bridge financing must be pretty profitable business if one can judge from the following letter an investment security house is sending to a number of well-known engineers:

> Just at this time we are particularly interested in discovering sites for toll bridges, and we hope that you may be able to discover a number of likely sites for us.
>
> We shall be glad to compensate you to your entire satisfaction for informing us of any suitable projects which you bring to our attention. All projects submitted to us will be promptly considered and an officer of our buying department will be sent to confer with you on all developments which appears feasible.
>
> We enclose a stamped self-addressed envelope for your convenience in informing us of your views on this matter. Any communications from you will be held in strictest confidence.

* * *

A New Spurt

(224) *Casement Window Engineers*—Employed by the Truscon Steel Company.

(225) *Commencement Engineer*—Professor Higbee, of the University of Iowa, according to the official *News Bulletin* of that institution. He has "the job of arranging for the thousand and one details that make a successful commencement."

(226) *Diplomatic Sub Engineer* — Mr. Bhimji K. Chotai, of Nawa Darvaja, Una, Kathiawar, which is in India.

(227) *Results Engineer*—A new breed coming to be quite common in public utility companies.

(228) *Shingle Engineer*—Not a ladies' barber as you might imagine, but Mr. Barney Le Valley of the Spaulding Logging Co.

(229) *Fumigating Engineers*—A variation of our old friends the "exterminating engineers." Advertised in the Philadelphia *Bulletin*.

(230) *Laminated Wood Engineering*—Practiced by a gentleman at Verona, N. J.

Personal Notes

O. L. HEMPHILL, state highway engineer for Arkansas, resigned, effective May 1, and became associated with Harvey Brown, a contractor of North Little Rock, Ark., in a corporation known as the Harvey Brown Construction Co., Mr. Hemphill being vice-president. The office of the corporation is in North Little Rock. Mr. Hemphill's successor in the state highway work has not been appointed, but G. HUNTER SYKES, assistant state highway engineer, has been made acting state highway engineer until a permanent appointment is made.

C. T. HOLDEN, who has been general superintendent for the Realty Construction Co., of Flint, Atlanta, and Jacksonville, has concluded his connection with that company to accept a similar position with R. R. Kitchen & Co., of Wheeling, W. Va.

HADLOW, HUGHES, HICK & CONRAD is the name of a company, at Cleveland, Ohio, newly organized by H. Ralph Hadlow and Noel H. Hick, who were formerly associated as Hadlow, Hick & Co., engineers, and by Harry D. Hughes and Edward G. Conrad, who have practiced architecture under the firm name of Hughes & Conrad. This organization, with offices in the Union Mortgage Building in Cleveland, brings together two firms which have for years been engaged in the practice of engineering and architecture. The firm will engage in the architectural and engineering design of all kinds of buildings and their equipment.

NELSON I. RAYMOND has been appointed city engineer of Owosso, Mich., as announced by the city commission.

J. H. ELLISON, Minneapolis, Minn., a former president of the Associated General Contractors, has been named as president of the Winston-Dear Co., which has its headquarters in Minneapolis, to fill the vacancy caused by the death of W. O. Winston.

FRED Y. NELSON has been appointed to the Jacob E. Decker & Sons fellowship at Iowa State College for the study of disposal of packing house wastes. Mr. Nelson is a graduate of the University of California in sanitary engineering, for the past year has been assistant city manager of San Rafael, Calif., and prior to that was employed by Chester H. Loveland, Inc., consulting engineers in San Francisco.

PORTER ALLEN, division superintendent in the central region of the Pennsylvania R.R., has been promoted to chief engineer of maintenance-of-way of the western region, with offices at Chicago, to succeed the late W. L. EKIN. Mr. Allen, who entered the service of the Pennsylvania R.R. as a rodman in 1920, became division engineer in 1920 and division superintendent in 1923.

SCOTT E. MCCULLOUGH was elected city engineer of Bloomington, Ill., and took office May 2. Mr. McCullough has been assistant engineer for the past eight years and succeeds THOMAS M. LANCASTER, who died Dec. 24, 1926.

Engineering Societies

Calendar

Annual Meetings

CONFERENCE OF STATE SANITARY ENGINEERS, Washington, D. C.; Annual Meeting, Chicago, Ill., June 4-6, 1927.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago, Ill.; Annual Convention, Tulsa, Okla., June 6-8, 1927.

AMERICAN INSTITUTE OF QUANTITY SURVEYORS, Chicago, Ill.; Annual Meeting, Washington, D. C., June 6-8, 1927.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Meeting, Chicago, Ill., June 6 to 11, 1927.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, French Lick, Ind., June 20-24, 1927.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, New York City; Annual Meeting, Orono, Maine, June 27-30, 1927.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Summer Meeting, Denver, Colo., July 13-16, 1927.

The Engineers' Club of Northern Minnesota will hold its next regular meeting June 4 at Burntside Lodge, near Ely, Minn. The board of directors of the Minnesota Federation of Architectural and Engineering Societies will also be in session there at that time, and the two organizations have invited the Duluth Engineers' Club to attend also.

Obituary

EMILE LOW, Buffalo, N. Y., U. S. assistant engineer, retired, died May 24 at his home in Buffalo, aged 73 years. Mr. Low was especially known for his work on construction of the Buffalo breakwater and his connection with the early plans for the New York Barge Canal. He was born in Pittsburgh, Pa., and educated in the public schools of Pittsburgh. His early work was in railroad surveys from Pittsburgh to Virginia on lines that were later absorbed by the Baltimore & Ohio R.R. or the Pennsylvania lines. In 1871 he made a survey of a section of the Monongahela River. Later he was chief engineer of the new Pittsburgh waterworks and on construction of the Highland reservoir; also in 1876 he was assistant city engineer of Pittsburgh. In the intervening and some later years he did railway work in Mexico and in Pennsylvania. Then he was engineer of the Mathieson Alkali Works at Saltville, Va. Mr. Low in 1869 became associated with the Corps of Engineers in work at Buffalo, under Col. T. W. Symons, and until his retirement in 1924 was engaged on many port and canal activities. The first great work was assisting Colonel Symons on his report for a canal from the Great Lakes to the Hudson River, generally known as the Barge Canal Report, which later led to the authorization of the barge canal. The years to 1903 were spent on the Buffalo breakwater, Mr. Low's position being that of assistant engineer, Corps of Engineers. From then to 1907 followed a leave of absence during which Mr. Low was in charge of barge canal work in Oneida County. Mr. Low was author of many papers on harbor work. He received the Norman gold medal of the Am. Soc. C. E. for a paper on the Buffalo breakwater.

WILLIAM S. DAWLEY, consulting engineer, St. Louis, Mo., died suddenly May 18 on a Missouri Pacific train. He was with a party of engineers who had started an inspection of the roads in the Southwest relative to valuation matters. Mr. Dawley was born in 1856 in Wisconsin and was graduated from the University of Minnesota in 1879. After serving in minor capacities on roads in the Northwest, he became principal assistant engineer of the Chicago & Eastern Illinois R.R. in 1888 and chief engineer in 1894, which position he held until 1906. He was also chief engineer of the Missouri & North Arkansas R.R. to 1909, and then served as chief engineer of the Yunnan Szechuen Railway Co. in China until 1913. During this period he made a reconnaissance of 1,400 miles and 600 miles of surveys in the mountainous section of southwest China. Since return to this country he has acted as consulting engineer on many important matters and more recently has been connected with valuation work for the Frisco and Missouri Pacific railroads. He was a charter member of the American Railway Engineering Association and a member of the Am. Soc. C. E.

WALTER W. CLIFFORD, consulting and structural engineer, of Clifford & Roeblad, Boston, Mass., died in January at his office in Boston. Mr. Clifford was born in Wiscasset, Maine, in 1888, was brought up by an uncle in Hyde Park, Mass., and graduated in civil engineering in 1909 from Massachusetts Institute of Technology. He was engaged first in harbor-dredging surveys, then for two years was an instructor at the Institute. After various services with the U. S. Forestry Service, with Metcalf & Eddy in charge of water supply and sewage disposal at the Institute of Technology summer surveying camp, and in the Charleston navy yard, he entered in 1913 the engineering department of Stone & Webster and did valuable work in connection with design of buildings for the Institute of Technology at Cambridge. In structural work he was associated with Densmore & LeClear from 1915 for two years and the next four years with the Harry M. Hope Engineering Co. In 1921 he became associated with S. G. Roeblad under the firm name above noted.

CAPTAIN G. A. BENNET, civil engineer, Montreal, Que., died May 20 at the age of 38 years. Owing to ill health he had gone to the Pacific Coast for the winter and had just returned to Montreal. Captain Bennet was born at New Glasgow, Que., and graduated at McGill University in 1911, and had since been engaged in the construction of elevators at Montreal, Fort William and Chicago. He was badly gassed in the war where he served with the 3rd Battalion of the Engineers Corps.

Construction Equipment and Materials

A Section Devoted to What the Manufacturer is Doing for the Engineer and Contractor

Extension Fund of $5,000,000 for Lumber Association

At the annual meeting of the National Lumber Manufacturers' Association, in Chicago, it was announced that the proposed $5,000,000 fund for a five-year trade extension program had been raised. Publicity of various kinds is one of the main objects of this enterprise. The organization and definite program are in the hands of the Trade Extension Committee, the chairman of which is H. B. Hewes, Jeanerette, La. The annual report of Wilson Compton, secretary and manager of the association, included the following statement.

"In view of the diversification of the commercial and industrial use of lumber and wood, increased by over 50 per cent in the last 15 years, it is not unlikely that the potential increases in the use of good lumber in high grade industrial uses may run literally into billions of feet annually; and that, with selling organizations functioning as efficiently as manufacturing organizations are now functioning, and with reliable information of the requirements of these industries and a willingness to meet these requirements as completely as diligence and ingenuity will permit, the price realization on lumber sold in such markets can be increased in tens of millions of dollars annually."

In an address on "New Competition in the Lumber Industry," by O. H. Cheney, vice-president, American Exchange & Irving Trust Co., it was pointed out that contributing to the above fund is not to be considered as a substitute for individual efficiency or individual advertising, but that the trade extension plan is simply a means for co-operation of individual effort and thus making it more effective. He suggested that lumber representatives, construction engineers, builders and research men might get together and list all the qualities of wood, with the substitutes for each. Then where wood showed an inferiority, ways should be devised for improving wood in that particular respect.

The association passed resolutions endorsing the tie specifications of the American Engineering Standards Committee and urging continued steps towards perpetuating the forest resources and forest industries. John L. Kaul, Birmingham, Ala., was elected president of the association, and Wilson Compton, Washington, D. C., was re-elected as secretary and manager.

Business Notes

RUSSELL GRADER MFG. CO., Minneapolis, Minn., announces that the following concerns have recently been made distributors of its products: W. D. Banker Road Machinery Co., Memphis, covering western Tennessee, northern Mississippi and western Kentucky; Arkanses Road Equipment Co., Little Rock, for the state of Arkansas; Clifford Waterhouse, Jackson, Miss., for the state of Mississippi; Kansas Road Equipment Co., Topeka, for the state of Kansas; Weber Implement & Automobile Co., Kansas City and St. Louis, for the state of Missouri; O. B. Avery Co., St. Louis, territory contiguous to St. Louis; Michigan Highway Equipment Co., Lansing, for the state of Michigan; T. J. Lane Equipment Co., Springfield, for most of the state of Ohio, and Ralph R. White, Cleveland, for the remainder of the state; Weber-Yoakum Road Equipment Co., Springfield, for the state of Illinois.

MASSILLON POWER SHOVEL CO., Massillon, Ohio, announces the purchase of the power shovel division of The Russell & Company and the plant and business of the Massillon Foundry & Machine Co., both of Massillon, Ohio.

PARADON MANUFACTURING CO., Arlington, N. J., announces that Prof. Earl B. Phelps of Columbia University has joined its staff as technical consultant and research chemist. Professor Phelps was formerly professor of sanitary chemistry at Massachusetts Institute of Technology and was afterward for a number of years with the U. S. Bureau of Public Health.

WALTER STUMPF, 33 years old, chief engineer of the Black & Decker Mfg. Co., Towson Heights, Md., was instantly killed May 14 when an automobile in which he was riding overturned.

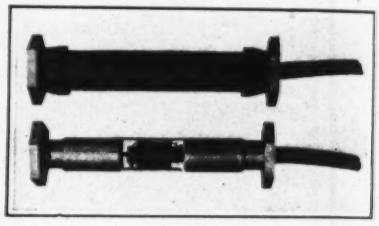
New Developments

Instrument Measures Strain and Temperature in Mass Concrete

The carbon-disk electric strain and temperature gage developed by McCollum and Peters of the Bureau of Standards, which has had its most important application in the experimental arch dam which the Engineering Foundation is building across Stevenson Creek in California, is now being manufactured and distributed by the Emery-Tatnall Co., 400 Washington Ave., Philadelphia.

The instrument has been named the "cartridge telemeter" and measures electrically the changes in strain or deformation due to changes of load and moisture, as well as changes in temperature in the interior of the concrete. In the accompanying illustration the top view shows the instrument with its cover in place which forms a seal effective for hydraulic pressures up to 750 lb. per sq.in. The lower view shows the cover removed, revealing the carbon resistor for measuring strain changes and concentric with this the resistance coil for measuring temperature changes.

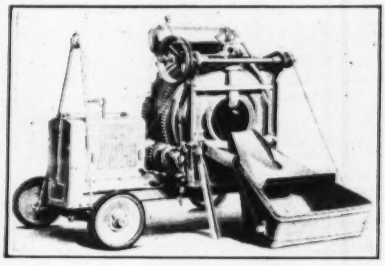
The cartridge is embedded when the concrete is poured and remains permanently in place, giving reliable information over a period of years. In the Stevenson Creek dam 150 of these instruments were used, placed horizontally, vertically and inclined at 45 deg., the latter being precast in a block of concrete. Connection to the outside is maintained through leads extending through the forms. Beyond the face of the structure these leads are connected to a three-wire, lead-covered cable which runs to an observation station at some convenient point. Leads from a number of cartridges are concentrated at a panel board at the observation station. A Leeds &



Northrup type S testing set, which is a form of Wheatstone bridge, gives the readings of strain, temperature and moisture changes of each cartridge as it is connected in turn to the various circuits on the panel board. It is said that changes in length of 0.00001 in. in 6 in. may be detected and measured. The company also states that it is in a position to furnish cartridge telemeters in the form of resistance thermometers, which are incased temperature coils mounted alone for measuring temperature within mass concrete.

5-S Mixer Built for Speed

A new 5-S mixer has been developed by the Koehring Co., Milwaukee, which embodies the latest improvements making for fast operation along with light



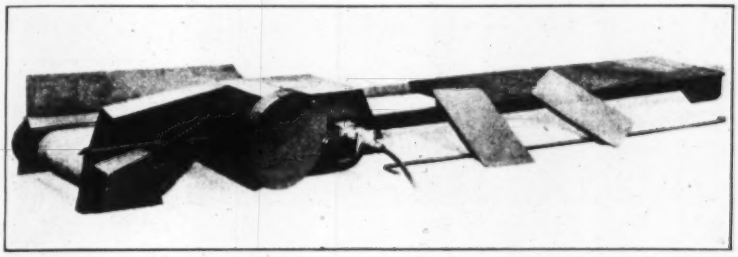
weight, compact design and sturdy construction. The mixer will handle a one bag batch of 1:2½:4 concrete.

The charging skip is low enough for wheelbarrow charging without building elevated runways or platforms. It is roomy and sufficiently long to chute the materials into the drum in one swift slide. The discharge chute has a clearange of 27 in. which allows wheelers to load barrows from the side or end according to the location of the mixer. An automatic water measuring tank is used equipped with an indi-

cator graduated in gallons for accurate and quick measurement. The machine is mounted on a narrow frame, equipped with either rubber tired or steel rimmed wheels. Power is furnished by a single cylinder, 4 cycle Universal gasoline engine, using a worm drive type transmission, completely inclosed and running in oil.

Belt Unloader for Hopper Cars

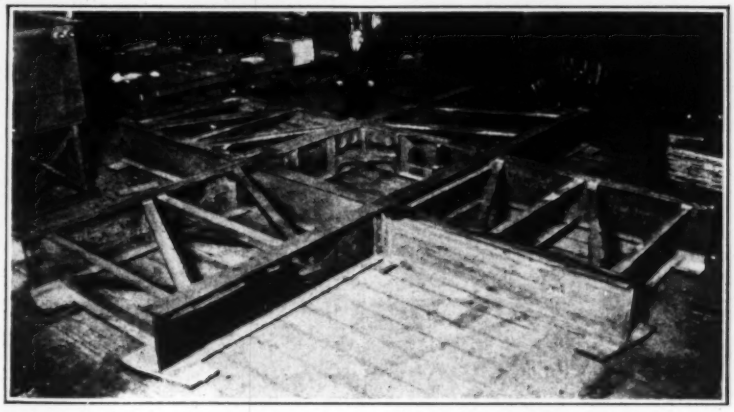
For contractors who find it frequently necessary to unload sand and gravel from hopper bottom cars, the Jeffrey Mfg. Co., Columbus, Ohio, has recently developed a light, compact belt conveyor unit known as the X-Track-Tor. It consists of a specially protected belt operated either with a gasoline engine or electric motor, the power unit being detachable for convenience in handling. The machine may also be operated from ordinary electric light current. It is 13 ft. long and 20 in. wide overall using a 16-in. three-ply rubber covered belt. The



machine rests over the rails under the hopper of the car taking up a space only 2¾ in. in height. The weight of the complete machine is a little over 600 lb., while the removal of the motor and other parts brings the heaviest piece to be handled down to 450 lb. In operation the flow of the material from the car is regulated by the hopper opening and by removable cover plates over the belt as shown in the accompanying illustration.

Arc-Welded Generator Bearing Brackets for Conowingo

The use of arc welding has recently been adapted by the Westinghouse Elec. & Mfg. Company to the construction of parts of the generators for the Conowingo, Maryland, hydro-electric project. The accompaying illustration shows the lower bearing bracket which weighs 16,000 lb. and will support one of the 40,000 kva. generators which are 37 ft. in dia. The bracket is a cross-shaped structure 24.9 ft. wide and long, and has a 68 in. opening in the center for the shaft. The bracket is built up of 24 in. standard girders with all joints arc welded. The heavy cast steel brackets about the center opening are also welded, round holes being cut in them for greater welding periphery.



Opaque Watertight Screen Material for Buildings

A product especially adaptable for use on construction building has recently been introduced by Acetol Products, Inc., 21 Spruce St., New York, N. Y. In reality it is wire screen mesh coated with a clear, transparent substance. It is claimed it will withstand the most severe hail or rain storms. It is known as Cel-O-Glass. The material is as flexible as the wire and is cut to fit with scissors. It is applied with hammer and staples as is wire. It may be repaired by a product known as Cel-O-Mend. It is made in shades of red, blue, green, amber and white, and a roll of 300 sq.ft. weighs 44 lb. It is also claimed that Cel-O-Glass is adaptable for use in place of tarpaulins.

Porous Concrete Made with Crushed Ice or Snow

A new porous and lightweight building material recently invented in Finland has been named "ice concrete." Ordinary cement and sand are used. The concrete is made porous by mixing with crushed ice or snow which is evaporated by heating. The porousness and therefore the weight of the blocks is determined directly by the amount of ice or snow used. It is claimed that the resulting concrete is a poor heat conductor and noise-proof.

By using only cement and ice or snow and leaving out the sand, a substance is produced which can be worked with tools and is said to have excellent qualities for ornamental work. It is also claimed that it will hold firmly nails or screws without cracking or crumbling. Henry A. Mayblom, 856 43d St., Brooklyn, N. Y., has supplied this information following a recent trip to Finland in which country a number of buildings have been erected with this type of block.

Manufacturers and Trade Associations

Calendar

Annual Meetings

WATERWORKS MANUFACTURERS ASSOCIATION, New York; Annual meeting, Chicago, June 6-10.

NATIONAL HARDWOOD LUMBER ASSOCIATION, Chicago; Annual Convention, Chicago, Sept. 15-16.

AMERICAN PAINT & VARNISH MANUFACTURERS ASSOCIATION, Philadelphia; Annual Convention, Atlantic City, Oct. 24-25.

NATIONAL ASSOCIATION OF MANUFACTURERS; Annual meeting, Chattanooga, Tenn., October 25, 26 and 27.

ASPHALT ASSOCIATION, New York; Annual Convention, Atlanta, Nov. 28-Dec. 2.

New Publications

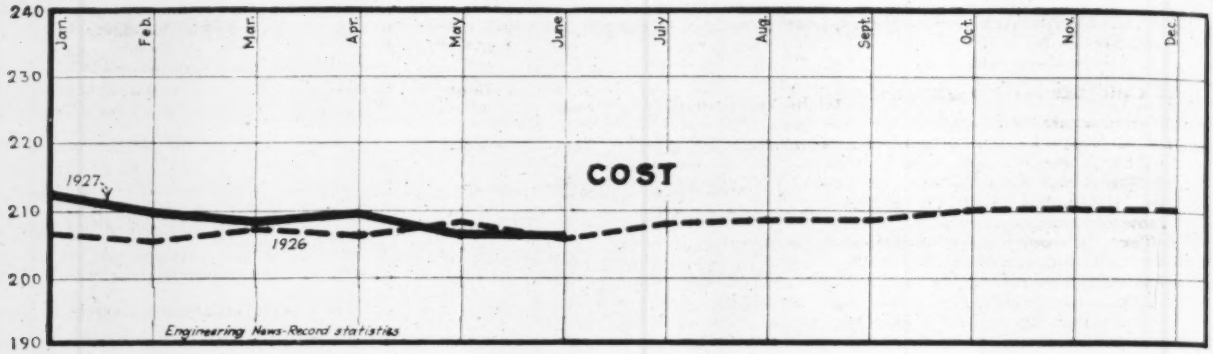
Zinc for Industrial Buildings—NEW JERSEY ZINC CO., New York City, has recently made available a 40-p. catalog on zinc roofing and siding for industrial buildings. Besides considering the economies and advantages of corrugated sheet zinc, practical information on the proper application is given and about a dozen pages on estimating and drafting office details.

Air Valves—SIMPLEX VALVE & METER CO., Philadelphia, Pa., has made available a 20-p. booklet devoted to air valves for pipe lines. The booklet is divided into two parts, both of which consist first of a technical approach to the general subject and second an application of the Simplex air and vacuum valves and automatic air release valves to the requirements that are necessary. The first part consists of notes on design of penstocks and thin walled water pipe, and the second part considers air in water pipe lines. Drawings are given showing methods of installation of valves on various types of pipe lines.

Lime Mortar—NATIONAL LIME ASSOCIATION, Washington, D. C., has issued bulletin No. 316 entitled "The Fallacy of Unnecessary Strength." It is a description of the use of lime in mortars, chiefly as used on brick and masonry work.

Engineering News-Record Statistics of the Construction Industry

June 2, 1927 — *in the United States* — Vol. 98, No. 22



***Engineering News-Record* CONSTRUCTION COST Index Number (1913 = 100)**

MONTHLY
January, 1926 to Date

June, 1927	205.55
May, 1927	206.80
June, 1926	204.80
Peak, June, 1920	273.80
1913	100.00

1926

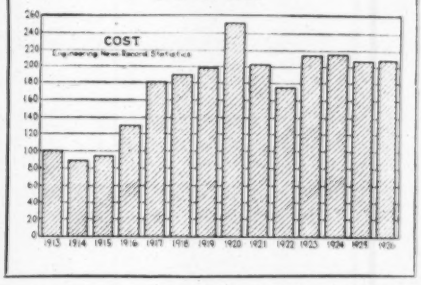
Jan	207.15	May	207.30	Sept.	208.30
Feb.	206.55	June	204.80	Oct.	209.80
Mar.	207.65	July	207.80	Nov.	210.80
April	207.05	Aug.	208.30	Dec.	210.80

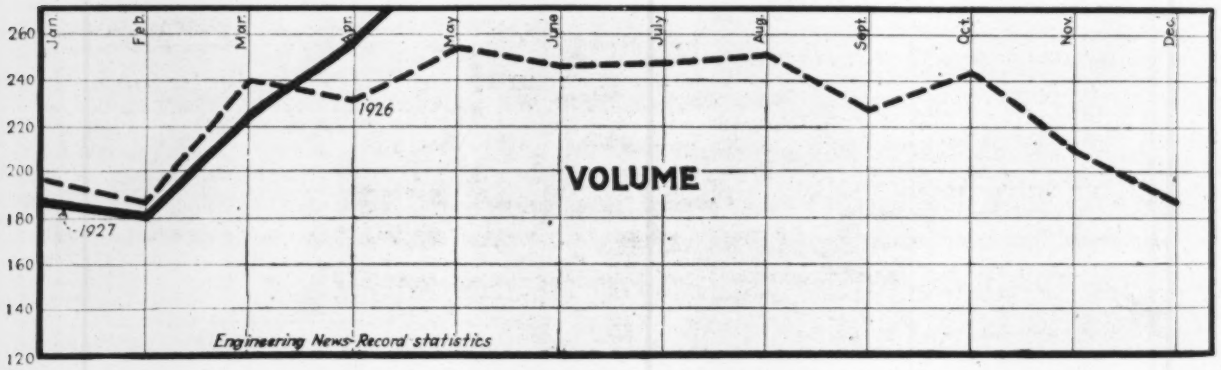
1927

Jan.	211.50	Mar.	208.80
Feb.	210.15	April	209.00

Engineering News-Record's Construction Cost Index Number is 0.6 per cent below May, 1927. The decrease is due mainly to lower prices of structural material. The average rate for common laborers is now 55½c. per hr., against 55c. at this time last year. Skilled labor rates continue to move higher. Thus, general construction cost is 0.3 per cent above June, 1926, 25 per cent under the peak and 105 per cent above 1913.

YEARLY
1913 to 1926





***Engineering News-Record* CONSTRUCTION Volume Index Number (1913 = 100)**

MONTHLY
January, 1926, to May, 1927

May, 1927	299
April, 1927	257
May, 1926	254
August, 1925	266
1913	100

1926

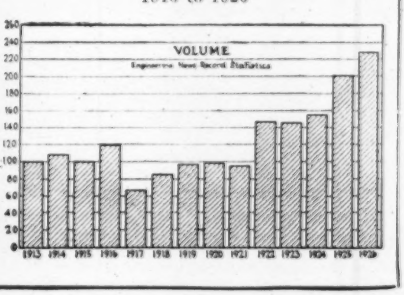
Jan.	198	May	254	Sept.	227
Feb.	187	June	246	Oct.	244
Mar.	240	July	248	Nov.	211
April	233	Aug.	252	Dec.	188

1927

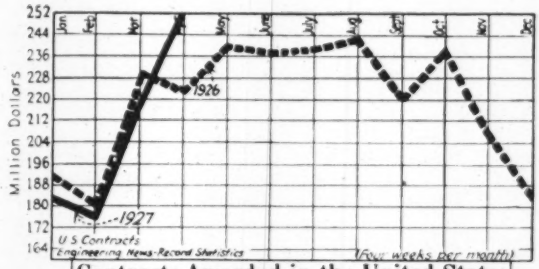
Jan.	187	Feb.	182	Mar.	226

Engineering News-Record's Construction Volume Index Number is 299 for the month of May and 228 for the whole of 1926, as against 100 for 1913. This means that the actual volume of contract letting in 1926 (not the mere money-value of the contracts let that year) is 128 per cent above the volume for 1913. The monthly volume number, 299 for May, 1927, contains the increment of construction and indicates the rate at which contracts are being let as compared with 1913 awards.

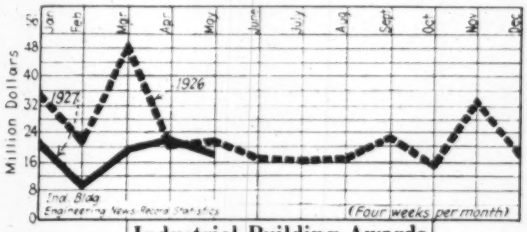
YEARLY
1913 to 1926



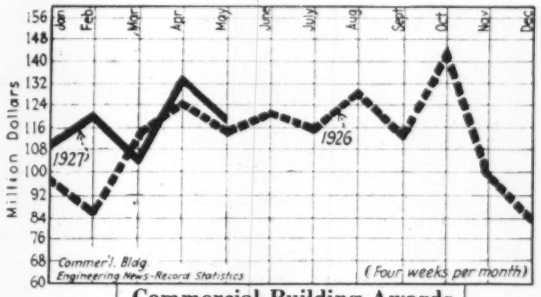
Monthly Statistics of the Construction Industry



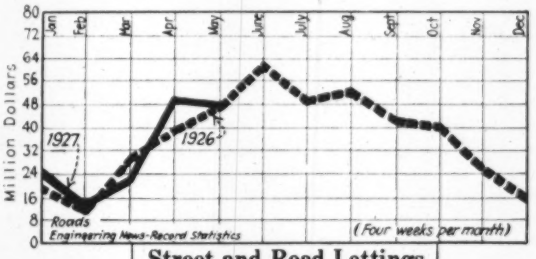
Contracts Awarded in the United States
Reported by E. N.-R.



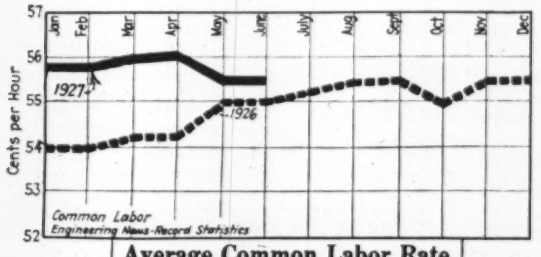
Industrial Building Awards
$40,000 and Over



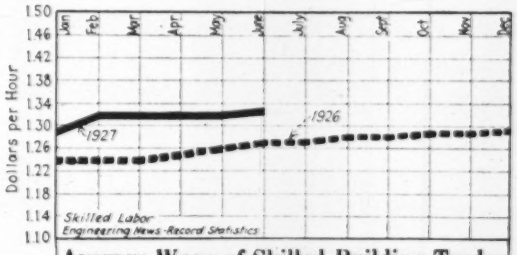
Commercial Building Awards
$150,000 and Over



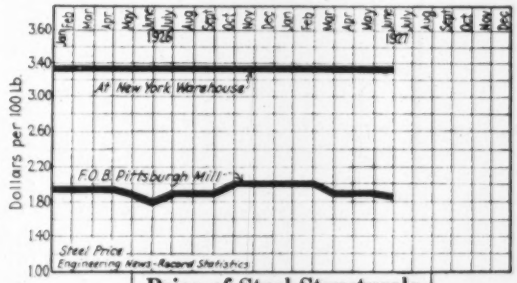
Street and Road Lettings
$25,000 and Over



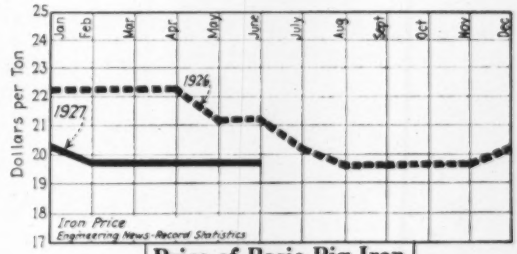
Average Common Labor Rate
Pick and Shovel Men



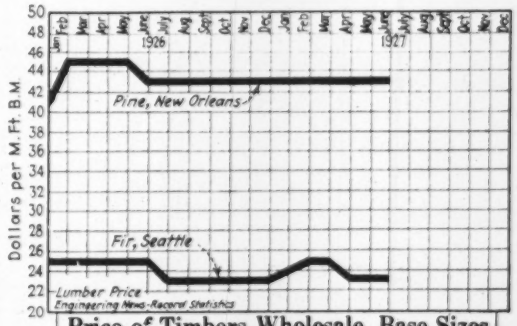
Average Wage of Skilled Building Trades
Bricklayers, Carpenters and Steel Erectors



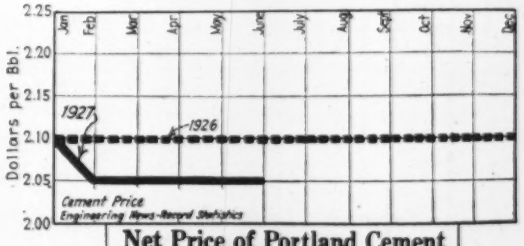
Price of Steel Structurals
Shapes 3-in; Plates ¼-in.



Price of Basic Pig Iron
F.o.b. Pittsburgh

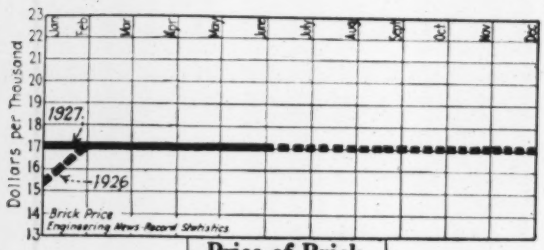


Price of Timbers, Wholesale, Base Sizes
Car Lots to Contractors

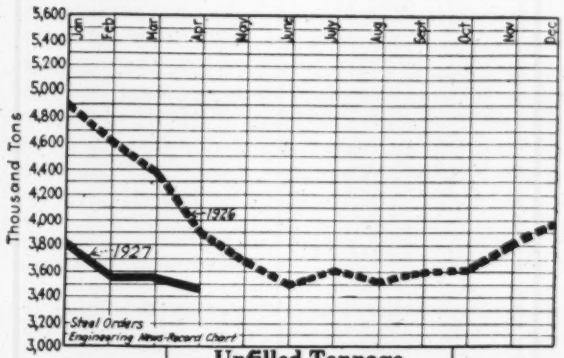


Net Price of Portland Cement
Car Lots F.o.b. Chicago

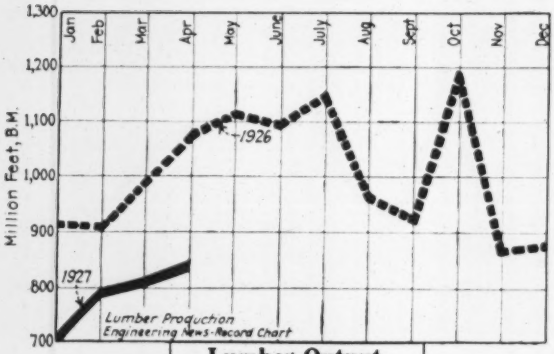
Monthly Statistics of the Construction Industry



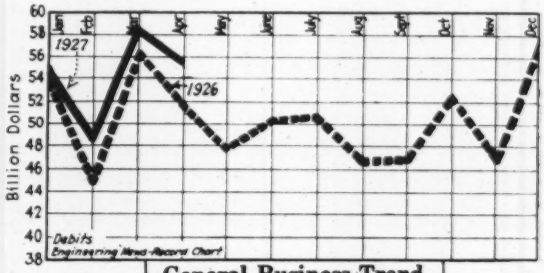
Price of Brick
At Dock, New York



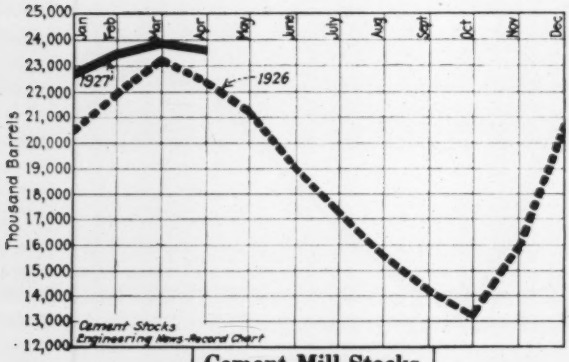
Unfilled Tonnage
On Books of U. S. Steel Corp.



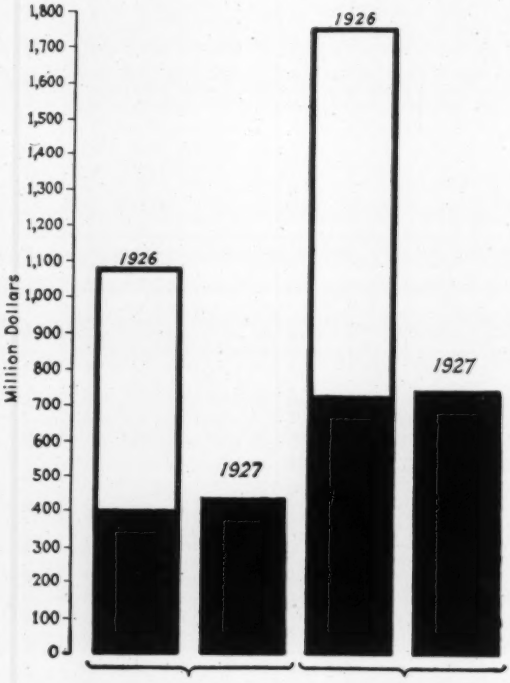
Lumber Output
Nat. Lumber Mfrs. Assn.



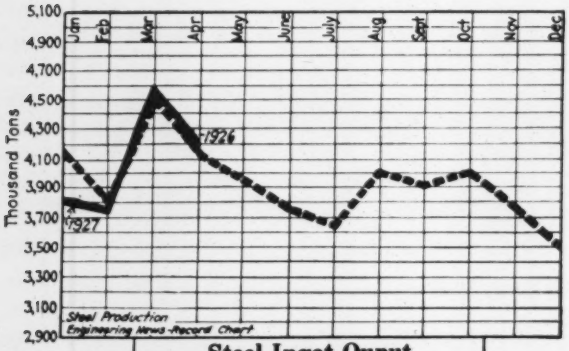
General Business Trend
Bank Debits—Federal Reserve



Cement Mill Stocks
Bureau of Mines



Public—Contracts—Private
Jan. 1 to date
Reported by E. N.-R.



Steel Ingot Ouput
Gross Tons; Am. Iron and Steel Inst.

More Money Spent For Construction Thus Far This Year Than In 1926

Big Pipe Line Contracts Furnish Bulk of Gain

THE approach of the mid-year mark finds the cumulative total of money spent for heavy construction in the United States, ahead of last year by a wide margin, according to figures compiled by E. N.-R.

The term "heavy construction" applies to engineering projects taking a minimum value, in each class, as follows: Water-works, excavation, drainage, irrigation, levee, river and harbor projects, $15,000; other public works, $25,000; industrial buildings, $40,000; commercial, educational, institutional, religious and other buildings, $150,000.

The cumulative total of $1,162,551,000 contains at least $40,000,000 in big pipe line contracts. The largest one was a 410-mi., gas pipe line, running from Panhandle, Tex., to Kansas City, Mo. This job was awarded by the Texas Corporation and the Columbian Carbon Co., Amarillo, Tex., to the Hope Engineering & Supply Co., Mt. Vernon, O., for $20,000,000 (E. N.-R. Mar. 24, 1927).

The second large pipe line job to develop was that awarded by the Empire Gas & Fuel Co., to the Youngstown Sheet & Tube Co., Youngstown, O., and Spang, Chalfant & Co., Pittsburgh, Pa. This line is to be 250-mi. in length and will carry natural gas from Amarillo, Tex., to Kansas City, Kans. (E. N.-R. May 19, 1927).

The last of the three was also a 250-mi. natural gas line, running from Wheeler and Gray Counties, in the Panhandle region of Texas, to Wichita, Kans. This project was awarded by the Cities Service Co. of New York City to Booth & Flinn, Ltd., Pittsburgh, Pa. (E. N.-R. May 26, 1927).

Deducting the money value of these pipe line jobs would leave the total for Jan. 1 to June 1, 1927, a fraction of one per cent over the 1926 amount for the same period. It would also reduce the May, 1927, value to a point about 7 per cent above April. At the same time a comparison of the corrected figures with May, 1926, would indicate a gain of 10 per cent, approximately, in favor of last month.

The index number on p. 922 of this issue, showing volume of contract letting, evidently indicates a record for any single month thus far. A glance at the first column of charts on p. 923 will show that the extraordinary increase was not in buildings nor even in paving projects. Unclassified contracts, Federal Government work, and public bridge projects made up most of the gains, comparing May, 1927, with the month preceding and with May, 1926. A comparison with May of last year shows substantial increases in awards for water-works, private excavating projects, streets and roads, and buildings of a commercial type.

Regional activity is indicated by the footings in the accompanying tabulation. By states, definite gains developed during May in Vermont, Massachusetts, Rhode Island, New York, Maryland, South Carolina, Ohio, Illinois, Michigan, Missouri, Arkansas, the Dakotas, Nebraska, Kansas, Texas, Montana, Wyoming, Colorado, New Mexico, Utah, Nevada, and California.

VALUE OF CONTRACTS AWARDED BY SECTIONS, MAY, 1927

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States	Jan. 1 to Date, U. S.	Canada
Waterworks	$195,000	$520,000	.....	$609,000	$1,323,000	$656,000	$3,303,000	**$23,608,000**	$290,000
Sewers	688,000	3,395,000	$84,000	4,376,000	1,655,000	1,428,000	11,626,000	**44,232,000**	345,000
Bridges	1,202,000	6,367,000	806,000	25,203,000	827,000	233,000	34,638,000	**54,890,000**	
Excavations, drainage, etc.	11,000	849,000	187,000	.....	101,000	545,000	1,693,000	**17,197,000**	129,000
Streets and roads	3,300,000	13,478,000	2,726,000	12,078,000	9,510,000	7,026,000	48,118,000	**164,670,000**	1,312,000
Industrial buildings	2,029,000	7,223,000	280,000	4,878,000	3,490,000	1,003,000	18,903,000	**97,947,000**	2,468,000
Commercial buildings	11,478,000	40,432,000	1,100,000	34,143,000	10,553,000	18,990,000	116,696,000	**613,130,000**	268,000
Federal Government	100,000	2,196,000	701,000	569,000	259,000	1,562,000	5,387,000	**19,650,000**	
Unclassified	265,000	2,596,000	1,468,000	691,000	35,521,000	4,375,000	44,916,000	**127,227,000**	8,867,000
May, 1927	$19,268,000	$77,056,000	$7,352,000	$82,547,000	$63,239,000	$35,818,000	$285,280,000	**$1,162,551,000**	$13,619,000
April, 1927	16,824,000	77,512,000	25,895,000	72,483,000	26,813,000	27,296,000	246,823,000	.....	10,042,000
May, 1926	22,656,000	68,617,000	34,945,000	52,619,000	40,210,000	22,290,000	241,337,000	.....	12,849,000
Jan. 1 to date, 1927	**86,538,000**	**332,644,000**	**83,740,000**	**297,910,000**	**207,920,000**	**153,799,000**	**1,162,551,000**	.....	37,592,000
Jan. 1 to date, 1926	78,939,000	375,763,000	142,138,000	243,851,000	159,018,000	122,673,000	1,122,382,000	.....	52,487,000

Labor Rates and Conditions Throughout the Country

No Let-up In Building Trades Wage Demands

STRIKES and wage controversies in the building trades continue to form faster than settlements can be effected, according to reports received by *Engineering News-Record* during the last thirty days.

A recession in volume of building contract letting, during the next six months, greater than that which occurred in the first half of the current year, will be necessary before the upward movement of skilled wages can be checked.

Charts on p. 923 show the direction of wage movements in both skilled and unskilled construction labor for the country as a whole. The fact that the skilled rate, when it moves, always goes upward, does not indicate that all sections of the country are free of unemployment in the building trades.

Over-supply of nearly all grades of construction labor exists in the Detroit and Philadelphia districts, while a great excess of common laborers is reported in Birmingham, Boston and Seattle.

The ten strikes started during May in the United States and the one in Canada, involved electricians, carpenters, plumbers, painters, hod-carriers, stone masons, plasterers, bricklayers and building laborers. The seven settlements during the month in the U. S. and the two in Canada, were confined to the following trades: bricklayers, carpenters, plasterers, electricians, and building laborers.

During the boom years, structural iron workers were not conspicuous in movements for higher wages, such as those characterizing the bricklayers, plasterers and plumbers, of almost every locality. Distant rumblings are now heard in the direction of the iron workers, especially since this craft considers its work more hazardous than that of the bricklayers and also that the introduction of welding in place of riveting will increase the dangers involved. There is shortage of structural ironworkers in Montreal, where the wage for this trade is 85c. per hr., against $1.75 in New York.

The principal strikes and wage controversies developing during May were as follows:

New York, N. Y.—Plumbers, on strike in Brooklyn since Apr. 1, have reduced their demands for $14 per day to $13.20 but still adhere to the five-day week idea. The present wage in this craft is $12 per day with a 44-hr. week. About 1,500 men are involved in the Brooklyn strike. Members of this craft in Manhattan and the Bronx, to the number of 5,000, who acted in sympathy with the Brooklyn plumbers, were locked out by the employers. These men have since returned to work by virtue of an injunction against the lockout. Plumbers in Queens were locked out by employers following their refusal to work on Brooklyn jobs vacated by the strike action.

Syracuse, N. Y.—Hod carriers and building laborers are on strike for an advance of 7c. per hr. from the present rate of 70c. Contractors have offered an increase of 5c. per hr. but without results.

Newark, N. J.—Electricians went on strike May 2, demanding an increase of $2 over the present rate of $12 per day. Thus far, no definite settlement has been reached.

Albany, N. Y.—Plumbers demand an

Current Building Trades Wage Rates Per Hour

(Higher rates than a month ago indicated by +, decreases by—)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	—$1.25@1.40	$0.60@.70	$0.70	$0.50	.....	$0.75	$0.25@.30
Baltimore	1.62½@1.75	1.00@1.10	1.00@1.37½	1.00	$0.65	1.00@1.25	.40
Birmingham	1.00@1.50	1.05	1.00	.50@.75	.....	1.75	.25@.40
Boston	1.40	1.25	1.25	.79	1.15	1.25	.45@.74
Cincinnati	1.50	1.35	1.35	.97½	1.35	1.35	.45@.60
Chicago	1.62½	1.10@1.50	1.00@1.50	.90@.96¼	1.50	1.50	.90
Cleveland	1.50	+1.37½	1.30	.87½	1.10	1.50	.87½
Dallas	1.62½	1.12½	1.00	.40@.75	1.00	1.25	.30@.50
Denver	1.50@1.62½	1.25	1.25@1.37½	.87½@1.00	.....	1.25	.31¼@.50
Detroit	1.56¼	1.00@1.25	1.00@1.10	.90	1.00@1.10	1.00@1.25	.50@.60
Kansas City, Mo	1.50	1.25	1.25	.90	1.25	1.25	.40@.75
Los Angeles	1.37½	1.00	1.00	.87½	.87½	1.00	.50
Minneapolis	1.25	.87½@95	.87½@1.00	.75	.....	1.00	.45@.60
Montreal	+1.25	.75	+.75	.40	.50	+.85	+.30@.35
New Orleans	1.50	.90	1.00	.75	.80	1.25	.30@.40
New York	1.75	1.50	1.75	1.12½	1.00@1.12½	1.75	.90⅝
Philadelphia	1.62½	1.12½@1.25	1.02½	.70@1.12½	1.00	1.37½@1.50	.45@.50
Pittsburgh	1.62½	1.50	1.37½@1.50	1.12½	.....	1.50	.80
St. Louis	1.75	1.50	1.50@1.65	1.15@1.25	1.25	1.50	.40@.75
San Francisco	1.37½	1.12½	+1.00@1.12½	.87½	1.12½	1.37½	.50@.60
Seattle	1.37½	1.12½	1.00@1.12½	1.00	1.00@1.12½	1.12½	.62½

increase of $1 per day over the old rate of $11 and painters ask for an advance of $1.80, against the present wage of $11. Both crafts went on strike May 2.

Chicago, Ill.—Refusal of inside carpenters to accept a wage cut of 10c. per hr. from the old rate of $1.20, resulted in the closing down of millwork establishments throughout the city.

Worcester, Mass.—Building laborers struck May 13 for 65c. per hr. as against the present range of 40 to 50c. The men also demand time-and-a-half for overtime and double time on holidays.

Newburgh, N. Y.—Hod carriers getting $8 per day, demand control of concrete work, where the prevailing open-shop rate is $5.

Norristown, Pa.—Carpenters striking for $1.25 per hr.; employers in favor of open shop.

New Haven, Conn.—Carpenters threaten walk-out unless master builders, who are now open-shop, recognize the union.

Greenwich, Conn.—Bricklayers, plasterers and stone masons are on strike for $14 per day, against the old rate of $12. Hod carriers demand $9, an advance of $1 per day.

Montreal, Que.—Inside wire workers and linemen are striking for a wage advance of 11c. per hr.

Settlements arrived at during the last month, follow:

Seattle, Wash.—Practically all building crafts are under signed agreement with employers to adhere to 1926 wages and working conditions, for the rest of the current year.

Portland, Ore.—Bricklayers, getting $11 per day, have returned to work after a strike action in which they demanded an advance to $12. The craftsmen have agreed to settlement of the dispute by arbitration.

Scranton, Pa.—Contractors to the number of 120 have signed an agreement to place the carpenters' rate at $10 per day. Settlement of electricians' demand for wage increase of $1 per day, to $10, pending.

Indianapolis, Ind.—Building trades mechanics all back at work following strike started April 1.

Poughkeepsie, N. Y.—Electricians granted increase to $1.25 per hr. from old rate of $1.12.

Minneapolis, Minn.—Plasterers signed up for three years. First year of the agreement carries present rate of $11, with an advance to $12 for the remaining two years.

Bridgeport, Conn. — Carpenters awarded rate of $12 per day and five-day week.

London, Ont.—Plasterers receive increase of 5c. per hr. over former rate of $1.10. The original demand was for $1.40 per hr.

Vancouver, B. C.—Agreement reached with building trades; labor cancelling demand for five-day week.

Monthly Prices of Construction Materials

Pacific Coast and Southwest Less Affected By Declines Than Other Parts of the Country

DEMAND for materials in the principal markets of the country measures fully up to the volume realized during the first twenty-two weeks of 1926, according to money value of contracts let. Costs in the meantime, have varied little, as shown by the chart on p. 922 of this issue. This statement refers to building materials particularly, since if the gas and oil pipe, etc., included in the three big line jobs awarded during the last month, were considered, the actual volume of requirements would greatly outweigh that of the corresponding period last year.

Recent production declines in some of the principal materials have been offset by commensurate increases in output of other and equally important items. The foregoing is true also of new orders booked. Shipments on old orders show three gains to one decrease. There are two instances of increasing stocks to every one of diminishing mill or yard reserves, in latest available reports.

In all parts of the nation the current price movement is downward, taking all building materials together, except possibly in the Pacific states and the Southwest.

Compared with May levels, however, seasonal advances appear in large-size sewer pipe, lumber, asphalt, paving stone, rivets, steel sheets, linseed oil, cement and brick. The principal declines occurred in iron and steel scrap, cast-iron pipe, small-size sewer pipe, lime, steel shapes, and wire nails.

Among the less important materials, advancing tendencies are noted in Douglas fir flooring, 1-in.; red cedar and cypress shingles; sheathing; and certain of the paint pigments. The downward trend continues in Douglas fir and North Carolina pine two-by-fours, wall plaster, and roofing materials.

Yellow pine prices in the Middle West have followed hardwoods in the upward movement started by the Mississippi floods. Douglas fir shows a greater tendency to fluctuate than long-leaf pine, but as in the latter, advances are considerably in excess of declines.

Brick prices remain firm despite the fact that importations (duty free) from Belgium, Holland, Norway and Italy, increased 43 per cent in quantity during the first quarter of this year, compared with the same period in 1926. Money value of these foreign bricks increased less than one per cent but at the same time, building plans for the period in question, dropped 5 per cent from those filed during the first three months last year.

E. N.-R. Prices of Construction Materials

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton f.o.b.:

	June 2	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25@2.75)	$22.19	$24.05
Northern Basic	20.89	24.27
No. 2 Southern Ohio (silicon 1.75@2.25)	21.19	24.27
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25@2.75)	26.37	28.37
BIRMINGHAM		
No. 2 Foundry (silicon 2.25@2.75)	18.50	22.00
PHILADELPHIA		
Eastern Pa., No. 2X (2.25@2.75 sil.)	22.76	23.26
Virginia No. 2 (silicon 2.25@2.75)	27.17	28.67
Basic	21.76	22.26
CHICAGO		
No. 2 Foundry Local (silicon 1.75@2.25)	21.00	22.50
No. 2 Foundry Southern (silicon 2.25@2.75)	23.55	26.05
PITTSBURGH, including freight charge ($1.76) from the Valley		
No. 2 Foundry Valley (silicon 1.75@2.25)	20.26	21.27
Basic	19.76	21.27
Bessemer	21.26	21.27

SCRAP—The prices following are f.o.b. per ton paid by dealers:

	New York	Chicago	Birmingham
No. 1 railroad wrought	$12.50@$13.00	$11.25@$11.75	$11.00@$12.00
Stove plate	8.00@8.50	12.25@13.25	13.00@14.00
No. 1 machinery cast	15.00@16.00	15.50@16.00	15.00@16.00
Machine shop turnings	7.00@7.25	6.00@6.50	8.00@8.50
Cast borings	7.50@7.75	8.75@9.25	8.00@8.50
Railroad malleable	11.25@11.75	12.75@13.25	12.00@13.00
Re-rolling rails	11.50@12.00	13.00@13.50	15.00@16.00
Re-laying rails	23.00@24.00		22.00@23.00
Heavy melting steel	7.75@11.25	10.75@11.25	12.00@12.25

Railway Supplies

STEEL RAILS—The following quotations are per ton f.o.b. for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh				
	June 2	One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$43.00	$43.00	$43.00	
Standard openhearth rails	43.00	43.00	43.00	43.00	$51.00
Light rails, 8 to 10 lb.		34@36	34@36	1.80@1.90*	2.05*
Light rails, 12 to 14 lb.	36.00	34@36	34@36	1.80@1.90*	1.88*
Light rails, 25 to 45 lb.	36.00	34@36	34@36	1.80@1.90*	1.84*
Re-rolled rails	30@34	30@33		34@36	

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, white oak, plain	$1.45	$1.83
Chicago, empty cell creosoted	1.85	2.45
Chicago, zinc treated	1.65	2.15
San Francisco, green Douglas fir	.84	1.14
San Francisco, empty cell creosoted, Douglas fir	1.70	2.25
St. Louis, white oak, plain	1.25	1.50
St. Louis, zinc treated	1.65	1.90
St. Louis, red oak, plain	1.15	1.40
St. Louis, sap pine-cypress	1.00	1.25
Birmingham, white oak	1.25	1.45

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh mill for carload lots, together with the warehouse prices at the places named:

	Pittsburgh					
	June 2	One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅝-in. and larger	$2.80	$2.80	$3.55	$3.65	$3.85	$3.00
Track bolts	3.90@4.25	3.90@4.15	4.55	4.60	5.35	3.90
Standard section angle bars, splice bars or fish plates	2.85	2.75@2.80	3.40	3.75	4.00	

Pipe

WROUGHT STEEL AND IRON PIPE—The following percentage discounts are to jobbers for carload lots at Pittsburgh mill:

	Steel			Iron	
Inches	Black	Galv.	Inches	Black	Galv.
BUTT WELD					
1 to 3	62	50½	1 to 1¼	30	13
LAP WELD					
2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			
BUTT WELD, EXTRA STRONG, PLAIN ENDS					
1 to 1½	60	49½	1 to 1½	36	14
2 to 3	61	50½			
LAP WELD, EXTRA STRONG, PLAIN ENDS					
2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

WROUGHT-STEEL PIPE—From warehouses at the places named the following discounts hold for welded steel pipe:

	Black		
	New York	Chicago	St. Louis
½ to 3 in. butt welded	53%	54%	49%
2½ to 6 in. lap welded	48%	51%	46%
	Galvanized		
	New York	Chicago	St. Louis
½ to 3 in. butt welded	39%	41%	36%
2½ to 6 in. lap welded	35%	38%	33%

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36 −5% off.

CAST-IRON PIPE—The following are prices per net ton for Class B and heavier f. o. b. in car load lots:

	Birmingham	Burlington, N. J.	New York June 2	New York One Year Ago
4 in.	$42.00	$49.00	$51.60	$55.60@57.60
6 in. and over	38.00	45.00	47.60	51.60@53.60
	Pittsburgh	Chicago	St. Louis	San Francisco
4 in.	$49.60	$48.20	$47.60	$56.00
6 in. and over	45.60	44.20	43.60	52.00

Gas pipe and Class "A," $4 per ton extra.

CLAY DRAIN TILE—The following prices are per 1,000 lin.ft.:

	New York					
Size, In.	June 2	One Year Ago	St. Louis	Birmingham	San Francisco	Dallas
3	$45.00	$45.00	.....	$45.00	.....	$73.00
4	56.00	55.00	$50.00	56.00	$76.50	110.00
5	.....	.....	.....	80.00	97.75	118.00
6	80.00	90.00	85.00	100.00	127.50	150.00
8	150.00	160.00	195.00	165.00	212.50	210.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In.	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	.....	$0.072	$0.10	.....	$.088	$0.12	.....
4	.....	.072	.10	$0.1175	.088	.15	$0.15
5	.....	.099	.135	.....	.121	.18	.18
6	$0.24	.099	.21	.1645	.121	.21	.21
8	.38	162	.315	.26	.198	.30	.325
10	50	2415	.45	.364	.315	.42	.476
12	66	3105	.54	.468†	.405	.56	.612
15	1 12†	414	.75	.78†	.54	.92	1.02
18	1 62†	575	.90	1.092†	1.00	1.32	1.53
20	1 95†	69	1.20	.....	1.20	.....	.....
21	.....	.805	1.25	1.456†	1.40	.....	.....
22	2 60†	.92	1.35	.....	1.60	.....	1.564
24	2.92†	1.035	2.665	1.872†	1.80	2.16	2.04
27	4.65†	2.08	2.952	2.95†	2.75	3.00	3.34
30	5.16†	2.304	3.96	3.65†	3.75	3.60	4.06
33	6.98†	4.05	4.51	4.45†	4.50	.....	4.99
36	8.00†	4.6125	5.06	4.80†	5.00	.....	5.42

	3	5	8	12	24	36
Boston	$0.125	$0.18	$0.25	$0.48	$1.85†	$5.20†
Minneapolis			.25	.45	1.50	4.56
Denver	.135*	.18*	.27	.47	1.70	.....
Seattle	.14		.35	.63	2.52	.....
Los Angeles	.1675	.186	.2825	.5085†	2.034†	.....
New Orleans	.....	.....	.205	.40	2.27	3.50
Cincinnati	.105	.1575	.245	.4725	1.575	4.715
Atlanta	.10*	.15*	.25	.425	1.625	.....
Montreal‡	.....	.50	.70	1.50	6.00	.....
Detroit	.081	.122	.189	.405	2.07†	4.715†
Baltimore	.111	.166	.259	.499	1.665	4.92
Kansas City, Mo.	.15	.21	.335	.54†	1.90†	3.80†
Philadelphia	.105	.15	.245	.40	1.40	3.50

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡Freight allowed.

Road and Paving Materials

ROAD OILS—Following are prices per gallon in tank cars, 8,000 gal. minimum f.o.b. place named:

		June 2	One Year Ago
New York, 45% asphalt	(at terminal)	$0.0725@$0.075	$0.065@$0.07
New York, 65% asphalt	(at terminal)	.0675@.0725	.0675@.0725
New York, binder	(at terminal)	.07@.075	.07@.075
New York, flux	(at terminal)	.07@.075	.07@.075
New York, liquid asphalt	(at terminal)	.07@.075	.07@.075
St. Louis, 40@50% asphalt		.052	.055
St. Louis, 50@60% asphalt		.0554	.0565
Birmingham, 55% asphalt		.0475	.0475
Dallas, 45% asphalt		.0495	.0495
Dallas, 50% asphalt		.0455	.0455
Dallas, binder		.061	.061
San Francisco, binder, per ton		12.00*	12.00*

* F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

E. N.-R. Prices of Construction Materials

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Texas*)	$24.50	
Boston (*Mexican*)	**24.00**	**$19.50**
Chicago (*Texas*)	28.00	23.00
San Francisco, *f.o.b. refinery*, Oleum, Cal.	18.00	12.00
Dallas (*Texas*)	27.10	21.10
Seattle, *"D" grade, California, f.o.b. Richmond*	19.50	13.50
Denver (*California*)	24.00	
Minneapolis, *f.o.b. Twin Cities (Standard)*	28.10	22.10
St. Louis (*Mexican*)	26.00	23.00
Baltimore (*Standard Oil*) (*f.o.b. refinery*)	22.50	18.50
Montreal (*Imperial*) *	27.00	22.50
Atlanta (*Mexican*)	24.40	**19.50**
Detroit (*Mexican*)	24.00	19.00
Cincinnati (*Kentucky Rock*)		11.65
Maurer, N. J. (*Bermudez*)	30.00	
Maurer, N. J. (*Trinidad*)	23.00	
Philadelphia (*Mexican*)	20.00	18.00
Kansas City, Mo. (*Texas*)	27.00	22.00
Los Angeles (*"D" grade, California*)	***18.00**	*12.00
Birmingham (*Mexican*)	27.00	21.00
New Orleans (*Mexican*)	20.00	17.00

* F.o.b. El Segundo Refinery. Drums used in New York.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York (grade I)	5-in. granite, 30 blocks per sq.yd.	**$150.00** per M.
San Francisco	Basalt block 4x7x8	70.00 per M.
Chicago	about 5x8x5 dressed	3.60 per sq.yd.
	about 5x8x5 common	3.25 per sq.yd.
Boston	5-in. Granite	132.50 per M.
Atlanta	Granite	2.50 per sq.yd.
Detroit	5-in. Granite	3.00 per sq.yd.
Baltimore	Granite	2.85 per sq.yd.
Montreal	Granite	104.75 per M.
New Orleans	Granite, 4x8x4	2.75 per sq.yd.
Cincinnati	Granite	135.00 per M.
St. Louis	Granite, 4x8x4	1.65 per sq.yd.
Kansas City	Granite	3.85 per sq.yd.
Philadelphia	Granite	3.90@4.25 per sq.yd.
Minneapolis	Sandstone	2.74 per sq.yd.

FLAGGING—

New York	Bronx, 4 ft. wide	$0.24 per sq.ft.
	Manhattan, 4 ft. wide	.24 per sq.ft.
	Queens, 5 ft. wide	.26 per sq.ft.
	6x24-in. cross-walk	1.30 per lin.ft.

CURBING—*New York*: Bluestone per lin.ft., f.o.b. barge New York, 5x16 in., **90**c.; *St. Louis*: Class "A" straight, delivered, 5x18 in., $1.05 per lin.ft.; roundings, $1.80. *Birmingham*: Limestone, 5x18-in., $1.05 per lin. ft.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd.
New York	3	16	$2.40
New York	3½	16	2.70
Boston	3½	18	2.40
Chicago	4	16	2.25
Chicago	3½	16	2.10
St. Louis	3½	16	2.45
St. Louis	4	16	2.80
Seattle	4	16	Off market
Minneapolis	3½	16	2.50
Atlanta	3½	16	2.00
New Orleans	3	16	2.20
New Orleans	3½	16	2.30
New Orleans	4	16	2.40
Dallas	4	18	3.90
Baltimore	3½	16	None used
Montreal	4	16	4.50
Detroit	3	16	1.94
Cincinnati	3½	16	2.35
Kansas City	4	16	2.50
Philadelphia	4	16	None used

Construction Materials

SAND AND GRAVEL—Price for cargo or carload lots to contractor, *f.o.b.*, per cu.yd.; weight of sand 1½ tons per cu.yd., gravel, 1½ tons per cu.yd.

	Gravel				Sand	
	1½ In.		¾ In.			
	June 2	One Year Ago	June 2	One Year Ago	June 2	One Year Ago
New York (*alongside dock*)	$1.75	$1.75	$1.75	$1.75	$1.00	$1.00
Denver	1.90	1.90	1.90	1.90	1.00	1.00
Chicago	1.70	1.60	1.70	1.60	1.65	1.40
St. Louis	1.45†	1.45†	1.45†	1.45†	1.20†	1.08†
Seattle	1.25	1.50	1.25	1.50	1.25	1.50
Dallas	2.38*	2.38*	2.38*	2.38*	2.00*	2.00*
Minneapolis	1.65‡	1.65‡	1.65‡	1.65‡	1.25	1.25
Cincinnati	1.30†	1.40†	1.30†	1.40†	1.05†	1.35†
San Francisco	1.80	1.80	1.80	1.80	1.40	1.40
Boston (*on trucks at dock*)	1.75†	1.50†	1.75†	1.50†	1.25†	1.00†
New Orleans	2.10†*	2.60†*	2.60†*	2.60†*	1.80†	1.80†
Los Angeles	2.00†*	1.15†	2.00†*	1.15†	1.40†	.90‡†
Atlanta	1.90†	1.90†	1.90†	1.90†	1.60†	1.50†
Detroit	1.70	1.45	1.60	1.35	1.35	1.10
Baltimore	1.40	1.40	1.60	1.60	.70‡	.70‡
Montreal	1.90†	1.25†	1.50†	1.50†	1.35†	1.25†
Birmingham	2.00*	2.00*	2.00*	2.00*	1.50	1.50
Philadelphia	2.25*	2.10*	2.25*	2.10*	1.65	1.50
Kansas City, Mo.					.66‡	.66‡
Pittsburgh	.85‡		.85‡			

*Delivered † Per ton

CRUSHED STONE—Price for cargo or carload lots, per cu.yd. f.o.b. cars as follows:

	1½ In.		¾ In.	
	June 2	One Year Ago	June 2	One Year Ago
New York	$1.84	$1.75	$1.94	$1.85
Chicago	1.70	1.75	1.87½	1.87½
St. Louis	1.83*	1.83*	1.83*	1.93*
Dallas	2.40†	2.40†	2.83†	2.83†
San Francisco	1.70	1.80	1.70	1.80
Boston (*on trucks at dock*)	2.10*	1.60*	2.10*	1.60*
Minneapolis	1.75	1.75	1.75	1.75
Kansas City (*quarry*)	2.00	2.00	2.00	2.00
Denver	2.50†	2.50†	2.50†	2.50†
Seattle	3.00†	3.00†	3.00†	3.00†
Atlanta	2.50*†	2.50*†	2.50*†	2.50*†
Cincinnati	1.65*	1.90*	1.65*	1.90*
Los Angeles	2.00*†	1.40*	2.00*†	1.42*
Detroit	2.60*†	2.00*†	2.60*†	2.00*†
Baltimore	2.50†	2.50†	2.55†	2.55†
Montreal	1.80*	1.80*	2.00*†	1.70*
Philadelphia	2.25†	2.10†	2.25†	2.10†
Pittsburgh	2.75†	2.85†	2.75†	2.85†
Cleveland	2.70*†	3.25*†	2.70*†	3.25*†
Birmingham	2.00†	2.00†	2.00†	2.00†

* Per ton. † Delivered.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plant

	1½-In	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.40	$2.00	$1.30
Buffalo District	1.25	1.35	2.25	1.25
Birmingham, Ala	.90	1.25	2.05	.80
Cleveland, Ohio	1.70*	1.70*	....	1.40*
Eastern Pa. and Northern N. J.	1.25	1.25	2.00	1.25
Western Pennsylvania	1.25	1.25	2.00	1.25
Toledo, Ohio	1.25	1.25	1.50	1.25

*Includes freight charge.

LIME—Warehouse prices:

	Hydrated, per Ton		Lump, per Barrel	
	Finishing	Common	Finishing	Common
New York	$18.20	$11.00	$3.50*	$2.10@3.00*
Chicago	20.00	18.00	....	1.50†
St. Louis	23.50	17.50	....	2.03*
Boston	18.25	11.00	3.50*	2.10@3.00*
Dallas	19.00	....	....	1.82†
Cincinnati	16.80	11.90	....	11.40‡
San Francisco	27.50	24.00	....	1.70†
Minneapolis	25.50	21.00	....	1.70†
Denver	24.00	....	....	2.70*
Detroit	15.50	11.50	....	12.00‡
Seattle, *paper sacks*	24.00	....	2.80†	....
Los Angeles	**26.00**	**18.00**	2.40†	11.00‡
Baltimore	24.25	17.85	2.55†	....
Montreal	....	21.00	....	10.00‡
Atlanta	22.00	13.00	....	1.50†
New Orleans	24.00	15.00	2.60†	2.50*
Philadelphia	23.00	17.00	....	....
Kansas City	17.50	15.00	2.66†	2.50*
Birmingham	22.50	16.00	2.40†	1.85†

* Per 280-lb. bbl. (net). † Per 180-lb. (net). ‡ Per ton.

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, exclusive of bags:

	June 2	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.55	1.50
Cincinnati (Utica)	1.72	1.72
Boston (Rosendale)	2.75	2.60
St. Louis (Carney)	2.75	2.85
Birmingham (Magnolia)	pozzolan cement	2.40	2.40

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	June 2	One Month Ago	One Year Ago
New York, del. by truck	$2.35@$2.50	$2.35@$2.50	$2.50@$2.60
New York, alongside dock to dealers	2.03	2.03	2.15
Jersey City	2.13	2.28	2.33
Boston	**2.30**	2.25	2.35
Chicago	2.05	2.05	2.10
Pittsburgh	2.04	2.04	2.09
Cleveland	2.24	2.24	2.29
Detroit	2.15	2.15	2.15
Indianapolis	2.19	2.19	2.29
Milwaukee	2.20	2.20	2.25
Duluth	2.04	2.04	2.09
Peoria	2.22	2.22	2.27
Cedar Rapids	2.24	2.24	2.34
Davenport	2.24	2.24	2.29
St. Louis	2.05	2.05	2.20
San Francisco	2.51	2.51	2.31
New Orleans	2.40	2.40	2.30
Minneapolis	2.22	2.22	2.32
Denver	2.85	2.85	2.85
Seattle	2.65	2.65	2.65
Dallas	2.05	2.05	2.05
Atlanta	2.35	2.35	2.25
Cincinnati	2.32	2.32	2.37
Los Angeles	**2.56**	2.50	2.36
Baltimore	2.50	2.50	2.35
Birmingham	2.40	2.40	2.40
Kansas City, Mo.	2.10	2.50	2.35
Montreal	**1.36**	1.15	1.42
Philadelphia	2.40	2.50	2.41
St. Paul	2.22	2.22	2.32
Toledo	2.20	2.20	2.20

NOTE—Bags 10c. each, 40c. per bbl.; 20c. each in Canada, 80c. per bbl.

Current mill-prices per barrel in carload lots, without bags, to contractors

Buffington, Ind	$1.80	Hudson, N. Y.	$1.75
Universal, Pa	1.80	Leeds, Ala	1.85
Steelton, Minn	1.85	Hannibal, Mo	1.90
Fordwick, Va	2.05	Lehigh Valley District	1.75
Mitchell, Ind	1.90	Wyandotte, Mich	1.90
Iola, Kan	1.85	Alpena, Mich	1.75
Mason City, Ia	1.80	Kingsport, Tenn	**2.05**
La Salle, Ill	1.90		

E. N.-R. Prices of Construction Materials

TRIANGLE MESH—Price per 100 sq.ft. in carload lots at mills; from warehouse in less-than-carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago District Mill	Warehouse New York	Warehouse St. Louis	Warehouse Dallas	Warehouse San Francisco
032	22	$0.99	$1.01	$1.39	$1.06	$1.13	$1.22
049	28	1.26	1.29	1.76	1.35	1.38	1.55
068	35	1.54	1.58	2.16	1.66	1.67	1.91
093	45	1.98	2.03	2.77	2.13	2.00	2.46
126	57	2.45	2.51	3.45	2.63	2.55	3.03
153	68	2.92	2.99	4.11	3.14	3.15	.....
180	78	3.35	3.43	5.70	3.60	3.47	.....
245	103	4.43	4.53	6.21	4.75	4.58	.....
287	119	5.12	5.24	7.19	5.50	5.26	6.35
336	138	5.93	6.07	8.35	6.37	6.11	.....
395	160	6.88	7.04	9.65	7.38	7.12	.....
PAVING							
036P	17	$0.76	$0.77	$1.06	$0.81	$0.76	.....
053P	24	1.07	1.09	1.50	1.14	1.07	.....
072P	31	1.35	1.38	1.90	1.45	1.39	.....
097P	40	1.74	1.78	2.45	1.87	1.90	.....
049R	24	1.07	1.09		1.14	1.02	.....
067R	31	1.35	1.38		1.45	1.39	.....
089R	40	1.74	1.78		1.87	1.90	.....

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq.ft.

EXPANDED METAL LATH—Prices in less-than-carload lots per 100 yd. for painted:

Weight in pounds	New York	Birmingham	Chicago	St. Louis	San Francisco	Dallas
2.2	$17.50	$19.50	$17.50	$16.50	$19.00	$24.00
2.5	18.50	21.50	18.50	17.50	21.00	26.00
3.0	21.00	24.50	21.00	20.00	24.00	29.00
3.4	22.50	27.50	22.50	21.50	26.00	31.00

BARS, CONCRETE REINFORCING—Current quotations per 100 lb., in carload lots, f.o.b., except at New York and St. Louis warehouses:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse New York	Warehouse Chicago	Warehouse St. Louis	Warehouse Dallas	Warehouse San Francisco
½ and larger	$1.90	$2.00	$3.24	$2.30@$2.50	$3.15	$2.75	$2.95
⅝	2.00	2.10	3.34	2.40@2.60	3.25	2.85	3.05
¾	2.10	2.20	3.44	2.50@2.70	3.35	2.95	3.15
⅞	2.30	2.40	3.64	2.70@2.90	3.55	3.10	3.35
1	2.90	3.00	4.24	3.30@3.50	4.15	3.75	3.95

For standard classification of extras for size and cutting of steel bars, see bar card of July 15, 1923

ROLLED FROM RAILS

	St. Louis	Dallas		St. Louis	Dallas
½ in and larger	$2.25	$2.48	½	$2.65	$2.88
⅝	2.35	2.58	¾	3.25	3.48
⅞	2.45	2.68			

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common June 2	Common One Month Ago	Common One Year Ago	Paving Block 3-inch*	Paving Block 3½-inch*
New York (del.)	$19.00-20.00	$19.00-20.00	$20.40	$45.00†	$51.00†
New York (at dock)	16.00-17.00	16@17	17.00		
Chicago	12.00	12.00	12.00	42.00	45.00
St. Louis, salmon (del.)	15.00	15.00	16.00	40.00	42.50
Denver, salmon	9@10	9@10	12.00	.....	.....
Dallas	14.10	14.10	14.10	35.00	.....
San Francisco	14.00	14.00	15.00	.....	.....
Los Angeles	10.00	10.00	11.50	(not used)	
Boston (del.)	20.00	20.00	18.50	45.00	50.00
Minneapolis (del.)	13.75	13.75	14.25	.....	.....
Kansas City	14.50	15.50	15.00	(no market)	
Seattle	14.00	14.00	15.00	.....	55.00
Cincinnati	15.50	15.50	17.00	40.00	45.00
Montreal	20.25	20.25	17.50	100.00‡	.....
Detroit (del.)	14.00	14.00	16.00	38.40	41.50
Baltimore	19.00	18.00	18.00	40.00	45.00
Atlanta	12.00	12.00	10.50	40.00	.....
New Orleans	15.00	15.00	15.00	60.00	75.00
Birmingham	14.50	14.50	12.50	40.00	45.00
Philadelphia	18.00	18.00	18@19	40.00	50.00
Pittsburgh (del.)	17@18	17.00	16.00	.....	.....
Cleveland	14@16	14@16	14.00	.....	.....

*For paving blocks 3x8½x4 and 3½x8½x4 respectively. †In cars. ‡Imported.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York June 2 on Trucks*†	New York One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco†	Perth Amboy N. J., Factory*
4x12x12	$0.1027	$0.1112	$0.076	$.011	$0.068	$0.108	.....
6x12x12	.1541	.1667	.104	.....	.09	.156	.....
8x12x12	.1926	.2084	.142	.21	.126	.244	.....
10x12x12	.....	.....	.182	.....	.158	.....	$0.2388
12x12x12	.....	.....	.202	.32	.186	.....	.2956

*5 per cent off for cash. †Partition tile.

	4x12x12	8x12x12	12x12x12
Boston	$0.08	$0.15	$0.25
Minneapolis (f.o.b. cars)	.072	.125	.225
Cincinnati	.064	.1295	.1726
Kansas City	.088	.154	.252
Denver	.085	.155	.22
Seattle	.10	.18	.26
Los Angeles	.085	.172	.285
New Orleans	.11	.205	.31
Detroit	.0707	.1326	.1853
Montreal	.10	.....	.....
Baltimore	.124	.268	.....
Atlanta	.0895	.1837	.....
Dallas	.112	.19	.31
Birmingham	.11	.124	.255
Pittsburgh	.068	.128	.179
Cleveland	.07	.12	.....

STRUCTURAL MATERIAL—Following are base prices per 100 lb. in carload lots, f.o.b. mill, Pittsburgh and Birmingham, together with quotations in less-than-carload lots from warehouses at places named:

	Pittsburgh Mill	Birmingham	Warehouse New York	Warehouse Dallas	Warehouse St. Louis	Warehouse Chicago	Warehouse San Francisco
Beams, 3 to 15 in.	$1.80@$1.90	$2.05	$3.34	$4.15	$3.25	$3.10	$3.00
Channels, 3 to 15 in.	1.80@1.90	2.05	3.34	4.15	3.25	3.10	3.00
Angles, 3 to 16 in., ¼ in. thick	1.80@1.90	2.05	3.34	4.15	3.25	3.10	3.00
Tees, 3 in. and larger	1.80@1.90	2.05	3.34	4.15	3.35	3.10	3.00
Plates, ¼ in. thick and heavier	1.80@1.90	1.95	3.34	4.15	3.25	3.10	3.00

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh Mill	Warehouse New York June 2	Warehouse New York One Yr. Ago	Warehouse Chicago	Warehouse St. Louis	Warehouse San Francisco	Warehouse Dallas
½ in.	$2.75	$5.00	$4.50	$3.50	$3.75	$5.00	$4.75
CONE HEAD BOILER							
½ in.	$3.15	.....	$4.70	$3.70	$3.90	$5.20	$5.00
⅝ and ¾	3.30	.....	4.85	3.80	4.15	5.35	5.15
⅞ and 1	3.55	.....	5.10	4.05	4.10	5.60	5.50

NAILS—The following quotations are per 100 lb. keg from warehouse:

	Pittsburgh Mill	Birmingham	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2.50	$2.85	$2.95	$3.35	$4.25	$2.83	$4.95
Cut	2.80	2.90	.....	5.00	5.00	2.93	5.00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco Galv.	San Francisco Black	Seattle Black
½	$7.50	$5.75	$7.75
⅝	7.05	5.30	5.65
¾	6.90	5.15	5.50

Pittsburgh base in lots of 200 kegs or more, $3.30.

PREPARED ROOFINGS—Slate-surfaced roofing in rolls weighing 85 to 90 lb. costs $1.93½ per 100 lb. to contractors in carload lots f.o.b. New York.

Single shingles, slate finish, cost $5.62½ per square (sufficient to cover 100 sq.ft.) in carload lots, f.o.b. New York. Strip shingles (4 in.) f.o.b. New York, in carload lots to contractors, $4.27½ per square for the hexagonal shape.

ROOFING MATERIALS—Prices f.o.b. New York, to contractors in carload lots:

Tar felt per 100 lb	$3.25
Asphalt coating, per gal	.33
Asphalt felt, per 100 lb	3.40

WINDOW GLASS—United inches, 25, bracket size 6x8 to 10x15, single thickness "AA," 83 per cent; "A," 88 per cent; "B," 89 per cent. Double thickness "AA," 83 per cent; "A," 88 per cent; "B," 89 per cent discount from jobbers list at New York warehouses.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2.25	$3.60	$3.50	$3.75	$3.89
No. 12	2.30	3.65	3.55	3.80	3.94
No. 14	2.35	3.70	3.60	3.85	3.99
No. 16	2.45	3.80	3.70	3.95	4.09
Black					
Nos. 18 to 20	2.70@2.80	4.25	3.75	4.50	4.00
No. 22	2.85@2.95	4.40	3.90	4.65	4.15
No. 24	2.90@3.00	4.45	3.95	4.70	4.20
No. 26	3.00@3.10	4.55	4.05	4.80	4.30
No. 28	3.15@3.25	4.70	4.20	4.90	4.45
Galvanized					
No. 10	3.05@3.15	4.55	4.10	4.55	4.25
Nos. 12 to 14	3.15@3.25	4.65	4.20	4.65	4.35
No. 16	3.25@3.35	4.75	4.30	4.75	4.45
No. 18	3.40@3.50	4.90	4.45	4.90	4.60
No. 20	3.55@3.65	5.05	4.60	5.05	4.75
No. 22	3.60@3.70	5.10	4.65	5.10	4.80
No. 24	3.75@3.85	5.25	4.80	5.25	4.95
No. 26	3.95@4.05	5.50	5.05	5.50	5.20
No. 28	4.20@4.30	5.75	5.30	5.75	5.45

For galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per 7½-lb. gallon for raw oil:

	New York June 2	New York One Year Ago	Chicago June 2	Chicago One Year Ago
Raw in barrels (5 bbl. lots)	$0.87½	$0.84	$0.90	$0.85

E. N.-R. Prices of Construction Materials

WHITE AND RED LEAD—Per 100-lb. keg, base price, f.o.b. New York:

	Dry		In Oil	
	June 2	1 Yr. Ago	June 2	1 Yr. Ago
Red	$15.25	$15.25	$16.75	$16.75
White	15.25	15.25	15.25	15.25

Lumber

Prices wholesale, per M. ft. b.m., in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to contractors at yards.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$26.00	$27.00	$28.00	$31.00
3x6 and 8	26.00	27.00	28.00	31.00
4x4-6 and 8	26.00	27.00	28.00	31.00
3x10 and 12	26.00	27.00	28.00	31.00
3x14	30.00	30.00	32.00	34.00
4x10 and 12	26.00	27.00	28.00	31.00
4x14	30.00	30.00	32.00	34.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$28.00	$30.00	$32.00
6x14	34.00	36.00	38.00
8x10	28.00	30.00	32.00
8x14	34.00	36.00	38.00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York		Chicago	
	20 Ft. and Under L.L.Y.P.	22-24 Ft. L.L.Y.P.	20 Ft. and Under No. 1 L.L.Y.P.	Up to 32 Ft. No. 1 Douglas Fir
3x4 to 8x8	$40.00@$42.00	$41.00@$43.00	$38.50	$40.50
3x10 to 10x10	47.00@49.00	48.00@50.00	45.00	40.50
3x12 to 12x12	54.00@56.00	55.00@57.00	56.00	40.50
3x14 to 14x14	62.00@64.00	63.00@65.00	...	40.50
3x16 to 16x16	74.00@76.00	75.00@77.00	...	42.00

New York.—Wholesale price of long-leaf yellow pine timbers (rough) to dealers; to contractors, delivered from lighters to job, $5@$10 additional. Shortleaf pine costs $3 per M. ft. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 32 ft. and $1 for each additional foot from 32 to 36 ft.

Other Cities

	8x8-In. x 20 Ft. and Under				12x12-In. 20 Ft. and Under	
	P.	Fir*	Hemlock	Spruce	P.	Fir*
Boston	$48.00	$48.50†	$50.00	$52.00	$58.00	$58.50†
Seattle		24.00				23.00
New Orleans	36.00				43.00	
Baltimore	32.50	49.25	53.00	60.00	38.00	49.75
Cincinnati	37.00	73.00	73.00	85.00	48.00	77.00
Montreal	50.00	55.00			60.00	50.00
Los Angeles		*32.00*				*32.00*
Denver		33.25	34.25	34.25		34.25
Minneapolis	44.50	38.75	34.50		47.00	39.75
Atlanta	31.00				34.00	
Dallas	56.00				56.00	
Kansas City, Mo.	41.50	39.75			55.50	39.75
Birmingham	32.00				34.00	
Philadelphia	48.00	36.00	38.00	45.00	62.00	36.00
Detroit	*46.00*	*42.50*			58.00	42.00
St. Louis	41.00				53.00	

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir*	Hemlock	P.	Fir*
Boston	$44.00	$43.00†	$45.00	$49.00	$48.50†
Seattle		22.00			23.50
New Orleans	38.00	46.00		28.00	34.00
Baltimore	55.00	44.00	44.00	34.00	50.00
Cincinnati	70.00	79.00	75.00	38.00	85.00
Montreal	45.00	50.00	40.00	65.00	50.00
Los Angeles	.....	*24.50*	.....	.....	36.00
Denver	.....	32.25	33.25	.....	32.75
Minneapolis	43.50	36.75	34.75	37.00	34.75
Atlanta	22.00	.....	.....	28.00	.....
Dallas	52.25	.....	.....	56.00	.....
Kansas City, Mo.	49.25	43.75	.....	41.00	*36.25*
Birmingham	27.00	.....	.....	45.00	.....
Philadelphia	30.00	36.00	36.00	52.00	36.00
Detroit	40.50	37.00	.....	*46.00*	41.25
St. Louis	43.00	.....	.....	28.00	.....

*Douglas fir. †Prime.

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York:

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23½
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.21½	.25½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	.35	.41

Miscellaneous

STEEL SHEETPILING—The following price is base per 100 lb. f.o.b. Pittsburgh, with a comparison of a month and a year ago:

June 2	One Month Ago	One Year Ago
$2.20@$2.25	$2.20@$2.25	$2.25@$2.30

CONCRETE BLOCKS—Standard 8x8x16-in., delivered to job, each:

Denver	$0.22	St. Louis	$0.18*
Detroit	.16	Boston	*18@.20*
New Orleans	....	Minneapolis	.14*
New York (Brooklyn)	.18@.20	Philadelphia	.18@.20
Pittsburgh	.18	*F.o.b.	

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Plow steel round strand rope	35%
Special steel round strand rope	30%
Cast steel round strand rope	20%
Round strand iron and iron tiller	5%
Galvanized steel rigging and guy rope	7½%
Galvanized iron rigging and guy rope	+12½%

California, Oregon, Nevada and Washington: Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ½-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¼-in., 8 ft.; ⅜-in., 6; ½-in., 4½; ⅝-in., 3½; ¾-in., 2 ft. 10 in.; 1-in., 2 ft. 4 in. Following is price per pound for ½-in. and larger, in 1200-ft. coils:

Boston	$0.24	New Orleans	$0.21
New York	.24½	Los Angeles	.25
Chicago	.23	Seattle	.23
Minneapolis	.25½	St. Louis	.23½
San Francisco	.22½	Montreal	.17
Atlanta	.27	Detroit	.24½
Denver	.25@.26	Baltimore	.18
Cincinnati	.21	Kansas City	.28
Dallas	.31	Birmingham	.26@.27
Philadelphia	.25		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.265*	$0.2875*
Boston	*.22*	*.24*
Kansas City	.215	.235
Seattle	.165	.19
Chicago	.195†	.2175†
Minneapolis	.1917	.2123
St. Louis	.20	.22½
Denver	.2025	.2275
Dallas	.225	.306
Los Angeles	.1875	.2225
Atlanta	.23	.255
Baltimore	.22	.23
Cincinnati	.22	.245
Montreal	.1675	.1895
Birmingham	.22	.24
New Orleans	.235	.26
San Francisco	.1625	.1925
Philadelphia	.215	.24

*Special gelatin in case lots. †Quantities above 500 lb. and less than a ton

CHEMICALS—Water and sewage treatment chemicals, spot shipments in carload lots, f.o.b. works:

Sulphate of aluminum, in bags, per 100 lb	$2.00@$2.10
Sulphate of copper, in bbl., per 100 lb	4.95@5.00
Soda ash, 58%, in bags, per 100 lb	1.32½@1.37½
Chlorine, liquid, cylinders, per lb	.05½@.08
Hypochlorite of lime (bleaching powder) in drums, per 100 lb	2.00@2.10

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Atlanta	$0.58	Detroit	$0.29
Baltimore	.31	Kansas City	.735
Birmingham	.58	New Orleans	.67
Boston	.365	New York	.34
Buffalo	.265	Pacific Coast (all rail)	1.15*
Chicago	.34	Philadelphia	.32
Cincinnati	.29	St. Louis	.43
Cleveland	.19	St. Paul	.60
Denver	1.15*		

* Minimum carload, 50,000 lb., structural steel only; 80,000 lb., for other iron or steel products.